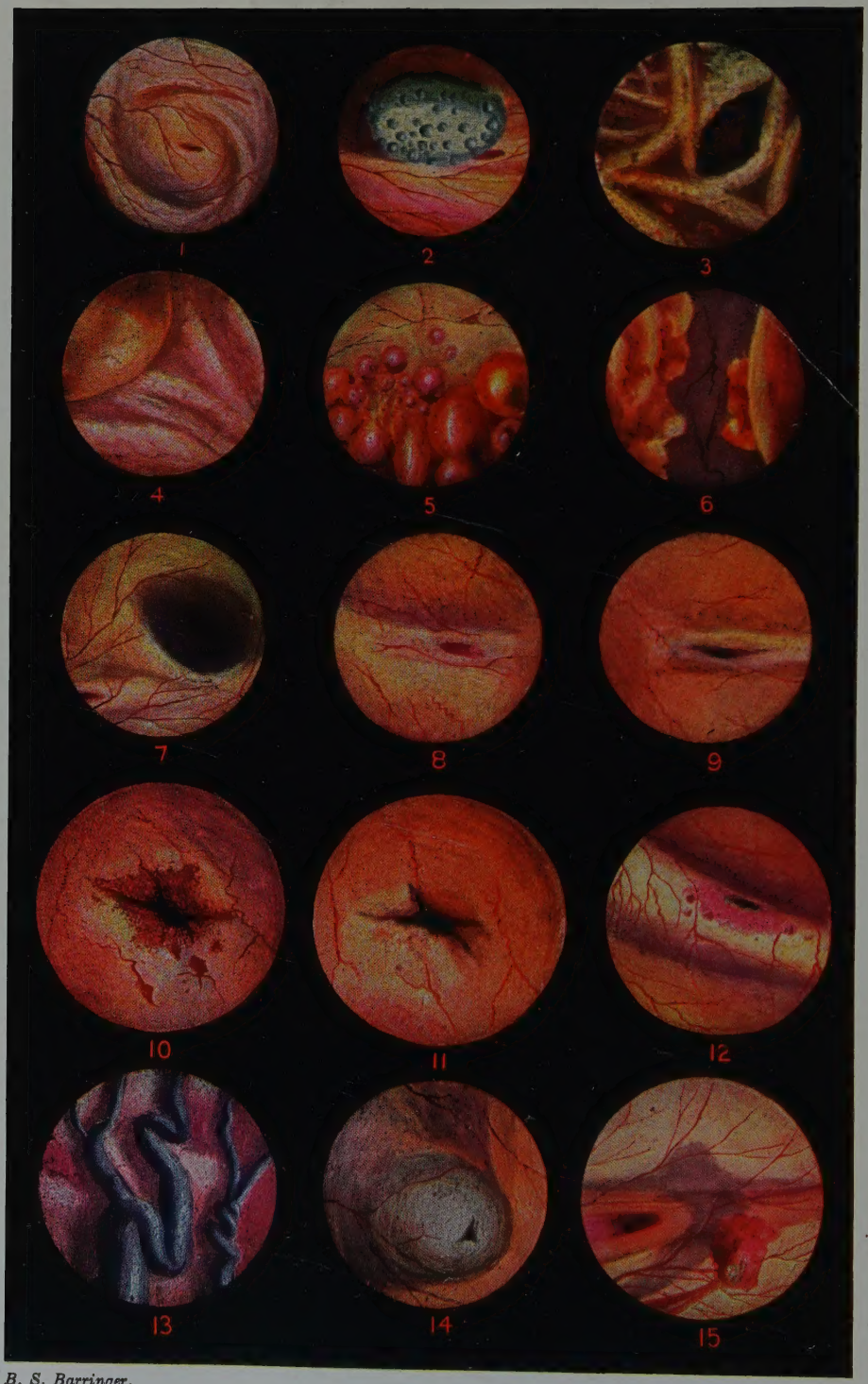
C. M. Parkinson

UROLOGY



B. S. Barringer.

PLATE I.—CYSTOSCOPIC VIEWS OF VARIOUS ABNORMAL CONDITIONS WITHIN THE BLADDER.

1. Cystocele.
2. Uric acid radionegative bladder calculus.
3. Tuberculation and sacculation of bladder.
4. Cystitis, depression of bladder wall by extravesical tumor.
5. Secondary carcinoma of bladder.
6. Enlargement and carcinoma of prostate.
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UROLOGY

BY

EDWARD L. KEYES, M.D., Ph.D., F.A.C.S.

PROFESSOR OF UROLOGY, CORNELL UNIVERSITY MEDICAL COLLEGE; UROLOGIST TO ST. VINCENT'S HOSPITAL; CONSULTING UROLOGIST TO BELLEVUE AND THE MEMORIAL HOSPITALS; ETC.

WITH ONE HUNDRED AND EIGHTY-FOUR ILLUSTRATIONS IN THE TEXT AND TWENTY PLATES, TWO OF WHICH ARE IN COLOR

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PRINTED IN THE UNITED STATES OF AMERICA

To

MY BELOVED FATHER

THIS BOOK IS AFFECTIONATELY
DEDICATED

PREFACE

In 1874, W. H. Van Buren, M.D., and E. L. Keyes, M.D., published *A Practical Treatise on the Surgical Diseases of the Genito-Urinary Organs,* a textbook of which this volume is the lineal descendant. The knowledge upon which the writing of the original volume was based was chiefly clinical. Any one could have collected the quoted writings of others but no one in this country at that time had the practical experience in the treatment of urinary cases of such variety and complexity as that which the junior author could boast to have acquired from his services at the Charity and Bellevue Hospitals of New York City. A similar experience of more than ten years' duration has placed under the observation of the present author all of the conditions discussed in this volume, if exception be made for a few of the rarer neoplasms.

Given this store of experience and a certain impatience with second-hand knowledge, this volume has skimped the responsibility of repeating anatomical, embryological, histological and bacteriological details which belong at the beginning of the study of medicine and which, in any case, are readily accessible elsewhere. One should respect the cry from the laboratory: "I can teach them their pathology!" By thus curtailing and by often hinting an opinion or suggesting points of view rather than developing them fully, it has been possible to confine the work within the limits of one volume.

The illustrations are almost all new and, in as much as the day has passed when a radiogram must be printed as taken lest one be accused of touching it up, it has seemed advantageous to reproduce all radiograms in line drawing. A few of these drawings are composite, including all of those that represent bilateral urograms. But each is sketched precisely and reduced mathematically from the original film.

The new arrangement of chapters and the many major and minor changes within the text need no advertisement. It has been the author's aim not only to express facts as lucidly as possible and to repress personal bias, but also to offer new lamps for old by expressing his opinions precisely as he holds them with all that curious human intermingling of certainty and doubt which is the result of more than thirty years' experience in the practice of medicine.

It is chiefly in the section upon operative surgery that the author can accuse himself of a narrow viewpoint. He has set down as precisely as possible the principles and practice of his own lifetime. Other surgeons are moved to other views—let them defend these.

Indeed, every effort has been made to breathe a little life into this textbook that it may approach more nearly the perfection of an oral tradition than have those editions which immediately preceded it. However personal the views

expressed, they are practical. One likes to believe that some of them date from Alexander Mott, the preceptor of Dr. Van Buren. There are pages here from Van Buren himself and from the author's father. There are surely many opinions derived from the vision of our associates, Gouley, Alexander, Fuller, Chetwood, Barringer, Mohan and Jeck.

The joy which the author has taken in Miss Freret's illustrations may be deciphered in his legends. In the construction of the present edition he has also been greatly assisted by the courtesy of Drs. A. R. Stevens and M. B. Parounagian for the use of photographs taken at Bellevue Hospital, and in many ways by Dr. A. M. McLellan.

To all the authors and inventors whose theories have been inadvertently stolen or whose practice has been clumsily described, apology is offered. Let those who have not been named set this oversight down to ignorance. Let those who have been misquoted believe that this was done without malice. Let the real inventors, whose material has been accredited to some scribe, concede at least that the scribe doubtless needs the advertisement more than they.

EDWARD L. KEYES

New York City

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UROLOGY

CHAPTER I

PHYSICAL EXAMINATION

The physical examination of a patient cannot be too thorough; errors in diagnosis are more often due to incomplete or careless physical examination than to any other fault. There are in the United States to-day innumerable victims of renal stone and tuberculosis being treated for an imaginary cystitis. There are prostatectomies done for pyelonephritis, for paralysis of the bladder and for the polyuria of arteriosclerosis or diabetes. Once I have seen a syphilitic testicle and several times subacute epididymitis operated upon under the erroneous diagnosis of tuberculosis. Several patients suffering from arteriosclerotic nocturnal polyuria have been referred to me for prostatectomy. I know of a patient who submitted for months to vigorous local treatment for a mild gleet while he was dying of chronic nephritis.

Such gross errors are due to careless physical examinations. Yet it would be hard to decide precisely what constitutes a complete and careful examination. It is certainly improper, for example, to cystoscope every patient with urethritis; yet it is eminently essential for some of them. Upon the wall of the hospital cystoscopic room I have always kept the temperature chart of a patient whose end had been hastened by cystoscopy.

The expert diagnostician shows his skill not only by basing his diagnosis on the salient points in the history and physical examination, but also and above all by recognizing the doubtful cases and exhausting for them every means of diagnosis at his command.

The general rule of physical diagnosis should therefore be this: Examine the patient to obtain a thorough knowledge not only of the disease from which he suffers but also of all possible complications and concomitant maladies that may have a bearing upon the prognosis or the treatment of this disease; and attempt examinations involving an element of danger only when you cannot reach a diagnosis without them.

Disease of the urinary organs is peculiarly prone to be complex. That a patient has prostatitis is no evidence that he has not pyelonephritis. That he has a stone in his bladder does not prove that he has not another in his ureter.

That he has a tuberculous prostate does not guarantee him against renal tuberculosis. These are but gross examples of the fact that we must be constantly on our guard against complex conditions in the genito-urinary tract of which the more obvious lesion may be the less important.

But what delights the urologist is the thoroughness with which he may make his diagnosis. When I was young, a renal colic was taken to mean the presence of stone, for ureter catheterization was a major operation and there was not any x-ray. The curability of urinary tuberculosis by nephrectomy was the fruit of Albarran's improvement of the cystoscope and his genius as a surgeon. But to-day, even a good x-ray does not satisfy us as diagnostic of stone and the presence of acid-fast bacilli in the urine is not sufficient for the diagnosis of urinary tuberculosis.

Before we decide to operate for stone, we must not only know that it is present, but we must also show the impairment of kidney function and have a urogram to guide us as to the exact location of the stone and to forewarn us of renal abnormality that might complicate the operation.

With the diagnosis of tuberculosis the same rules hold. The actual distinction between tubercle and smegma bacilli is by no means infallible, but the actual diagnosis of renal tuberculosis, including as it does the discovery of acid-fast bacilli, the proof of diminished renal function and of suppuration within the cavity of the kidney pelvis plus a characteristic urogram, is sufficient evidence of the presence and distribution of the lesion.

The early diagnosis of tumor of the kidney is, alas, our greatest difficulty to-day, for here suppuration is not present, function not impaired and perhaps the renal pelvis is so little invaded that the distortion of its cavity cannot be certified.

Yet this is the delight of urology, the complete, rounded, self-confirmatory diagnosis, not depending upon any certainty of observation in one single department, but requiring confirmatory evidence from history, general examination and the special methods of investigation that can be applied to the case.

As a matter of fact, these perfect diagnoses can only be produced by the constant interchange and even conflict of ideas between different types of mind. The adequately equipped urological clinic, of which Young's is the original and still perhaps the best exemplar, is a little scientific and clinical medical world in itself. At other institutions where the initiative of the chief is not adequate to maintaining contact with every new clinical and laboratory development, the urologist will be found leaning upon many other men for assistance in his diagnoses and therapy and for those oblique lights that strange, well-trained minds shed upon our work.

The detail of our physical examination should cover several fields, viz.:

General physical examination
External examination of the genito-urinary tract
Internal examination

GENERAL PHYSICAL EXAMINATION

As a routine one should note the age, the weight, and the circulatory, pulmonary, and digestive conditions of every patient. That such observation is most important may be demonstrated by the following list of conditions in which data concerning the vital functions are essential:

The condition of the circulation must be carefully studied in every renal case. The blood-pressure is especially important.

The condition of the lungs is preëminently important in tuberculosis and in operative cases.

The condition of the digestion is perhaps the most important of all. It affects the prognosis of even so local a malady as gonorrhea. It determines the dosage of sandalwood oil as well as of hexamethylenamin. It enters into the diagnosis of urinary toxemia.

Study of such important factors is therefore not time wasted. Yet the detail of such study is no special province of ours; it belongs to the general education of every qualified practitioner.

EXTERNAL EXAMINATION OF THE GENITO-URINARY TRACT

We may consider:

Palpation and percussion of the kidneys and ureters
Palpation and percussion of the bladder
Rectal palpation and recto-abdominal palpation
Palpation of the penis and urethra
Palpation of the scrotal contents

Palpation and Percussion of the Kidneys

The patient, with back and abdomen bared, lies upon his back with his knees drawn up and his hands on his chest, so as to relax the abdominal wall as much as possible.

If examination in this position proves unsatisfactory the patient may be turned upon the side opposite to that which is being examined. Lying thus with knees well drawn up, the kidney is sometimes more palpable; but, as a rule, this is not the case.

Palpation of the abdomen with the patient erect but bending slightly forward may reveal renal mobility that otherwise escapes observation. But many patients cannot relax the abdominal muscles while in this position, which is therefore but little employed.

The Operation.—If the kidney is very large its outline may be determined by abdominal palpation. Yet it is almost always necessary to employ lumbo-abdominal palpation.

Lumbo-abdominal palpation is performed as follows: To examine the *right* kidney the patient lies, as above described, at the edge of a couch, beside which, and to the right of the patient, the examiner sits. With the index and middle fingers of the *left* hand the examiner now identifies and makes pressure upon the triangular depressible spot below the last rib and just at the edge of the thick spinal muscles (the costomuscular angle). The *right* hand is then placed on the anterolateral abdominal wall—just external to the linea semilunaris—with fingers directed upward, and their tips just below the free border of the ribs (or of the liver if this be enlarged). This hand is pressed down as firmly as possible, taking advantage of the relaxation of the parietes between inspirations.

Ballottement.—With the hands thus placed the examiner may or may not feel a mass between them. In either event he gives a quick, sharp tap to the loin with the fingers of the left hand. The result of this is twofold, viz.:

1. It may elicit *costovertebral tenderness.* Deep tenderness confined to the region just below the ribs and external to the erector spinæ muscles is almost conclusive evidence of inflammation in or about the kidney. Myositis causes tenderness primarily in the lumbodorsal muscular wall.

2. It may elicit *renal ballottement.* This is the sensation, comparable to fetal ballottement, imparted to the fingers depressing the anterior parietes when a sharp tap from behind throws an intra-abdominal body against them.

Ballottement should be attempted first during normal respiration, then with the patient breathing deeply, just as the abdominal wall relaxes at the end of the inspiratory effort.

Renal ballottement discloses the presence of a movable mass in the loin. It does not prove that mass to be a kidney, nor, if kidney it be, that the organ is diseased. One may obtain ballottement from a mass of tuberculous glands, from a neoplasm, or from the "corset lobe" of the liver.

Yet as a clinical sign ballottement is most useful. When the kidney is normal in size and position ballottement can be obtained only if the patient is very thin and the abdomen very lax. But when the organ is abnormal in size or mobility and this abnormality is but slight, or when examination is impeded by fat or rigidity, ballottement may elicit the only evidence of this change.

The very movable kidney and the misplaced kidney are not in the loin, but may be palpated in the iliac region.

Simultaneous Bilateral Palpation.—Two types of gross abnormality in and about the kidney are calculated to escape detection by ballottement: (1) The pain and tenderness arising from trauma to or acute inflammation within the loin may excite a defensive muscular spasm sufficient to conceal an enlarged kidney. (2) Soft masses, *e.g.,* the incompletely distended large hydronephrotic sac, may be of such yielding character as to elude ballottement.

Under each of these conditions the presence of a mass in the loin may be detected by simultaneous bilateral palpation. The patient lies relaxed upon his back and the examiner grasps both loins (thumbs in front) and compresses them very gently so as not to elicit any defensive spasm whatever. Now, let the

patient breathe deeply and let the examiner bid him open his mouth, thus distracting his attention and gaining his confidence. In a few moments the lumbar muscles will relax and the bulk of any considerable mass in the loin will be readily felt.

Differential Diagnosis by Palpation

Palpation of the unenlarged kidney scarcely ever affords evidence as to the exact nature of disease in it. Nephroptosis is often diagnosed by palpation, and a tender kidney is usually inflamed. Perirenal exudates are sometimes characteristically diffuse. But with these exceptions palpation usually reveals little more than the fact that a mass in the loin probably is or is not of renal origin. Retroperitoneal and adrenal growths cannot be distinguished from renal enlargement by palpation.

The enlarged kidney usually forms an ovoid movable mass, in part concealed under the ribs, rising and falling with respiration, palpable by lumbo-abdominal palpation or ballottement. But when the kidney is greatly enlarged, or displaced and enlarged, it may be a delicate matter to distinguish the resultant tumor from enlargement of liver, gall-bladder, spleen, or pancreas. The kidney is more lateral in position than any of these organs and more readily distinguishable by lumbo-abdominal palpation.

Insufflation of the colon by a rectal tube and the bulb of a Paquelin cautery or an inverted Vichy bottle, may be of use in differential diagnosis.

On the right side the hepatic flexure covers only the lower pole of the kidney, but is adherent thereto (by the nephrocolic ligament of Longyear). Hence, if the kidney is greatly enlarged it brings the hepatic flexure in front of it, covering its lower extremity. Most other growths reach the abdominal wall distinctly above and to the inner side of the angle of the colon (*e.g.*, those of the gall-bladder, pancreas, pylorus), but enlargement of the right lobe of the liver descends external to and in front of it. Thus, the only tumor whose lower end is likely to be covered by the hepatic flexure of the colon is a renal tumor.

On the left side the transverse colon crosses in front of the lower third of the kidney and the descending colon lies external to it. But the lack of any definite attachment between the two organs permits the enlarged kidney to slip out from behind the colon. When the left kidney is sufficiently large to reach the abdominal wall, no hollow viscus intervenes. The descending colon borders the inner side of the mass. Enlargements of the spleen, on the other hand, reach the abdominal wall above the transverse colon.

Confirmatory Examination.—In as much as disease of the kidney either impairs the secretion of that organ or alters the shape of its pelvis long before it produces a palpable tumor, the main dependence in diagnosis is upon the catheterization of the ureters. A study of the urine thus obtained, confirmed if necessary by pyelography and the wax-tipped catheter, affords an accurate diagnosis with which the findings of palpation should conform.

Palpation of the Ureters

The ureters lie upon the posterior abdominal parietes. Their course may be divided into an abdominal and a pelvic portion.

The course of the ureter through the abdomen begins near the outer edge of the psoas magnus muscle opposite the third lumbar vertebra and the umbilicus. Thence it runs on the anterior surface of this muscle downward and a little inward, passing over the brim of the pelvis near the bifurcation of the common iliac artery. At their entrance into the pelvis the ureters are about 5 cm. apart.

The normal ureter cannot be palpated through the abdominal wall. Even when considerably enlarged it can only be felt if the parietes be thin and relaxed. Points of inflammation in its course may be identified as points of tenderness. But palpation cannot always distinguish tenderness in the ureter from some other disorder. On the right side an inflamed ureter is likely to be mistaken for cholecystitis or appendicitis; when on either side, for colitis.

The ureters follow the lateral walls of the pelvis in a wide curve whose convexity is outward and backward. As they enter the bladder they are about 4 cm. apart, though the vesical orifices are separated by but 2 cm.

Through the greater part of their pelvic course the ureters are totally impalpable. Just as they enter the bladder they become palpable if inflamed, in the anterior wall of the rectum.

They pass behind and below the uterine arteries at a point from 0.5 to 1.5 cm. lateral to the uterine cervix. Thence the direction is downward, forward, and inward—almost transversely—against and adherent to the anterior vaginal culdesac, to enter the bladder at a point about 2 cm. from the middle line at the junction of the upper and middle third of the vagina. Hence the sensitive or enlarged ureter may be palpated for over 2 cm. of its course as it runs transversely across the anterior vaginal culdesac. Yet it may be much more plainly felt in the rectum of either sex, and in the male at a point 1 cm. above the prostate and just internal to the seminal vesicle. The ureter catheter, the wax-tipped catheter and ureterography, however, form the basis of most diagnoses.

Palpation and Percussion of the Bladder

The bladder may be examined by abdominal palpation and percussion, by rectal palpation, and by recto-abdominal bimanual palpation.

An empty or partially filled bladder can neither be felt nor percussed through the abdominal wall. An infant's bladder, lying high in the pelvis, must contain at least 150 c.c. before it can be percussed; that of an adult, 300 c.c. or more. To be palpable it must contain about 1,000 c.c.

Percussion of the distended bladder gives a flat note over an area above the pubic bone, the dimensions of which depend upon the distention of the

bladder. This area may extend but an inch or two above the pubes or it may rise up to or even above the umbilicus.

Palpation is only possible when the bladder is distended at least halfway to the umbilicus. The viscus is felt as a tense sphere rising from the pelvis.

When the bladder reaches the umbilicus and the abdominal walls are lax, the tumor in the hypogastrium may be distinctly visible.

Rectal Palpation: Recto-Abdominal Palpation

The prostate and the seminal vesicles, the base of the bladder and the lower end of the ureter, may be felt by a finger introduced into the rectum.

The examiner may protect his finger by a simple lubrication or by a rubber glove or a specially constructed rubber shield. The best protector for the finger is a rubber finger cot, using a new one for each examination, and a shield for the rest of the hand, made either by winding a gauze bandage about the finger or by tearing a hole in the midst of a small square of absorbent cotton. In his other hand the examiner holds a piece of gauze with which to wipe the grease from the patient's anus after the examination.

The patient's bladder should be moderately distended, preferably with boric acid solution. This is to be urinated out after the examination.

Some prefer that the patient should be upon his back with his knees drawn up, others that he should assume the knee-chest position, others that he should bend over a table with his heels apart, his toes turned in, his knees slightly bent, his back "swayed." Most patients can be effectively examined in the position last described. With his left hand upon the patient's left shoulder the examiner may exert counterpressure to drive his finger as far as possible up the rectum. The examiner may steady his right hand by bracing the elbow against his right knee.

As the index finger is introduced with its sensitive pulp forward toward the anterior rectal wall, it slips through the two sphincters and enters the rectal cavity above.

Examination of Membranous Urethra and Perineal Body.—With the index finger hooked down and the thumb on the patient's perineum an examination of his body may be made for indurations (cowperitis, periurethritis). Just above this the finger in the rectum feels the membranous urethra, an almost imperceptible cord about 2 cm. long, in the median line. Boggy, lumpy, or tender infiltrations may perhaps be felt about it.

Examination of the Prostate.—As the membranous urethra is followed up the bowel it disappears within the apex of the prostate, which is felt beneath the anterior rectal wall.

The normal prostate as felt from the rectum is heart-shaped, with its apex joining the membranous urethra, its base more or less notched in the center, its lateral lobes quite elastic, its central groove between the two lobes more or less marked.

The normal prostate does not project into the rectum. Its lateral lobes are flat rather than bulging. Its mobility is to be noted. In order to examine it carefully the finger must be swept over its surface and around its borders. Great experience is required to recognize a normal prostate. So varied are the degrees of sensitiveness and of prominence of the organ, so frequently do we find phleboliths or enlarged glands lying upon it or near it, that the specialist is frequently compelled to confess that he can find nothing abnormal in a prostate that has been pronounced diseased by a less experienced examiner.

The chief signs of a normal prostate are: The lobes are flaccid, flat, insensitive.

An exquisitely sensitive prostate, like an equally sensitive urethra, may be anatomically normal. A sensitive and tense prostate usually contains pus. A prostate with rounded, tense insensitive lobes is usually hypertrophied, but may be simply inflamed. The relative roundness of the lobes is appreciated by sweeping the finger across them from side to side.

A prostate may be inflamed or enlarged or the seat of neoplasm and yet feel normal to rectal touch.

Cystoscopy and rectal palpation upon a sound in the urethra are of great assistance in diagnosis of carcinoma of the prostate.

There are no indurations in or about the normal prostate.

Discrete round masses on or near the prostate are usually glands or phleboliths. Indurations within the lateral lobes or projecting toward the seminal vesicles are usually inflammatory; they may be tuberculous or neoplastic.

The expressed secretion contains no pus.

Examination of the Vesicles.—The distinction between the seminal vesicle and the ampulla of the vas is not possible by rectal touch. If the perineum is deep or the prostate enlarged it may be impossible to insert the finger far enough up the rectum to reach the vesicle.

The normal seminal vesicle is impalpable.

The dilated or inflamed seminal vesicle is felt as an irregular, elongated mass beginning just above the prostate, laterally, and extending upward and outward beyond the reach of the finger. If greatly enlarged the vesicles may meet in the middle line, but usually there is a space about a finger's breadth in width between them. The inflamed vesicle feels doughy or doughy and lumpy. It may or may not be sensitive.

Examination of the vesicles may sometimes be made easier by counter-pressure on the hypogastrium.

A vesicle may be inflamed and yet feel normal to rectal touch.

Examination of the Base of the Bladder.—Neoplasms of the bladder and large stones in the lower end of the ureter may sometimes be felt by rectal touch in the space between the vesicles. Counterpressure on the abdomen is of assistance in this examination.

Bimanual Palpation.—Abdominorectal palpation reveals infiltrating carcinoma of the bladder, large stones, residual urine.

Palpation of the Penis and Urethra

This presents no peculiar difficulty other than that of identifying obscure circumscribed fibroses in the corpora cavernosa.

The urethra should be palpated upon a sound just large enough to fill it without distention. Careful palpation upon this reveals even the smallest infiltrations in and about the urethral wall.

Only the anterior urethra can be palpated externally. The membranous urethra must be palpated from the rectum. The prostatic urethra can scarcely be palpated.

Palpation of the Scrotal Contents

The testicle should be palpated by slipping it to and fro between the thumb and fingers. The chief characteristics to be noted are its size and tension as compared with its fellow, thickening of the epididymis, the presence of hydrocele, and of pathologic conditions in and about the testicle.

The normal epididymis must be carefully palpated many times before the examiner's fingers attain complete familiarity with its usual variations in size, consistence, and attachment to the testicle.

The presence of hydrocele is often a confusing element in diagnosis. Here again familiarity with the tension of a normal testicle and with the groove that separates it from the epididymis makes the alteration of that tension and the obliteration of that groove by hydrocele immediately recognizable.

The physician should also accustom his fingers to follow the vas deferens from its origin at the tail of the epididymis up to and into the inguinal canal, in order to recognize changes in its size or sensitiveness.

Dilated veins of the pampiniform plexus rarely have any clinical significance.

CHAPTER II

URINALYSIS

The foundation of urology is urinalysis. Without a thorough practical familiarity with this art as practiced in the laboratory and in the clinic, no man may expect to diagnose diseases of the urinary organs.

The practice of urinalysis is twofold: laboratory urinalysis and clinical urinalysis.

In the laboratory the urine is subjected to tests for acidity, specific gravity, albumin, sugar, indican, etc.; it is centrifuged and the cellular, crystalline, and bacterial content of the sediment noted.

Such an analysis every physician must be competent to perform. There is no special need, therefore, to dwell upon it here, except to insist upon certain points of peculiar interest to the urologist.

Urological Urinalysis.—The striking difference between urinalysis as practiced by the urologist and as practiced by the internist is the urologist's unwillingness to put up with a stale bottled specimen. To him the most important specimen of urine is that which has been freshly passed and in which he can discern the suspended crystals, cells and bacteria before they have even settled to the bottom of the glass, for to his accustomed eye each of these suspended particles has a special meaning. But in order to study the kidney function and to distinguish the source of pus, blood and epithelia he must study other samples of the urine, as follows:

The total output of urine for the twenty-four hours, so dear to the internist, is often carelessly overlooked by the urologist. Yet this should be a matter of record for every kidney case. The Mosenthal test, or some similar formula for studying the effect of food and drink, exercise and rest, upon the kidney function, is as essential a basis for the calculation of the renal power of concentration by the urologist as by the internist. Repeated comparative studies of the concentration of "night and morning" specimens will be needed to establish the measure of kidney exhaustion as expressed by nocturnal polyuria. The phenolsulphonephthalein test supports the conclusions reached and the ureter catheter separates the urine produced by the two kidneys. Note that the conclusions sought from every one of these tests in some degree overlaps those sought from each of the others. For none of them is quite infallible or all-covering. The urologist must learn at the outset not to depend upon any one test of renal function. He must familiarize himself with all.

In order to learn the source of pus in the urine this fluid must be examined in several ways, viz., as passed into two glasses, as passed after prostatic massage,

as obtained from the bladder by catheter and as obtained directly from the kidneys by ureter catheter. Each of the specimens thus obtained is subjected to a twofold analysis, by the examiner's eye and by the laboratory. The details of laboratory analysis are fully set forth in special works devoted to that subject. We shall confine our observations to examination by the eye, clinical urinalysis. And in this chapter we shall deal only with clinical urinalysis as it applies to the urine passed into two and three glasses.

CLINICAL URINALYSIS

Clinical urinalysis consists in looking at the urine and interpreting what we see therein. It suggests the nature and quantity of substances held in suspension in the urine. It suggests, also, in many instances, the part of the urinary tract from which these substances are derived. But *it is by no means infallible, and its findings must always be confirmed by laboratory urinalysis and by a physical examination of the patient.*

These propositions are fundamental. They seem to leave a very small place in the diagnosis for this clinical test whose only function is to suggest and not to prove. Yet, practically speaking, clinical urinalysis is employed far more constantly than the laboratory tests. At the first examination of a case it ofen—very often—gives the suggestion that leads ultimately to correct diagnosis, and in subsequent examinations it is our chief means of judging the progress of the case.

At the patient's first visit, therefore, the urine should be carefully inspected before it is submitted to laboratory tests, though the inferences made from inspection should not be acted upon unless the laboratory confirms them. At subsequent visits, on the other hand, clinical examination of the urine by inspection is always imperative, while laboratory examination is only required from time to time.

In short, *clinical urinalysis is useful for diagnosis, essential for prognosis.*

Technic of Clinical Urinalysis

It is by no means a waste of time to describe precisely what is meant by "looking at the urine." This does not mean looking at it as it lies in the bottom of an opaque vessel; it does not mean looking at it after it has shaken about in a bottle in the patient's pocket for hours; it does not even mean glancing at it casually in a dirty glass and by an imperfect light. What it does mean is this:

Let the patient present himself for examination at least two, and if possible three or four, hours after his last urination. Let him pass into a large, clean tumbler (a pint glass is the best size) about 50 c.c. of his urine, the rest into a second glass.

Now examine the contents of these two glasses against a strong light. No

speck or cloud in them is too insignificant to be noticed. View them intently and begin to draw tentative conclusions, recognizing that these conclusions are not final, but only important hints. "This is a foreign body." "This is a shred which, to judge by its size, comes from the anterior urethra. There is a speck of blood adherent to it." "This haze is opalescent, and, therefore, probably crystalline or bacterial." "This swirl of fresh blood still undistributed is more probably prostatic or urethral, possibly vesical."

Such are a few of the countless inferences drawn by the expert examiner. By making such deductions and confirming or refuting them in the laboratory or by physical examination, one soon learns to form rapid and accurate conclusions from data imperceptible to the inexperienced eye.

The accuracy of these inferences may be increased by:

1. The acetic acid test.

2. The comparison of the contents of the first and second glasses (for men only).

3. Comparison with these of a third glass of urine—for those cases in which the two-glass test might prove misleading.

The Acetic Acid Test.—The substances held in suspension in the urine are organic and crystalline. The former, pus, blood, bacteria, etc., form the object of the clinical examination, while the latter, crystals, though of considerable importance in the general diagnosis, are only confusing here. Their presence simply obscures the undissolved organic content of the urine.

Now of the various crystals that may cloud the urine, the earthy phosphates are the commonest and the most important. Urates and uric acid are rarely seen in any quantity in freshly passed urine, and their reddish color distinguishes them. Oxalates or cystin scarcely ever occur in such quantity as to cloud the urine,[1] but the phosphates are common and readily soluble by acidulation of the urine.

Therefore, if examination of the urine in two glasses shows that both are cloudy, since the phosphatic cloud may appear in both urines,[2] the glass

[1] I have several times seen an oxalate or a cystin cloud. They produce the same opalescent haze as do phosphates or bacteria, and are distinguishable only by the microscope.

[2] When the phosphates are in great excess they are not distributed evenly throughout the urine but, having settled in the bladder, are most concentrated in the last drops. In extreme phosphaturia this concentration of crystals in the last drops is so marked that the patient can occasionally squeeze from the urethra little gritty masses of phosphates left there after urination is complete.

The characteristics of this *phosphaturia,* as it is called, are the following: It occurs almost exclusively in youth, between the ages of fifteen and thirty-five. It is apparently due to a functional disturbance in assimilation, and is therefore commonly seen in young persons who work with their heads rather than with their hands, is often associated with functional dyspepsia, and like this is most marked at periods of mental stress. It never causes stone or inflammation of the urinary passages, and its association with pus in the urine is rare and purely accidental. Its chief clinical characteristic is its sudden appearance and disappearance; at one micturition the urine is milky with phosphates, at the next absolutely sparkling and clear. Its prognosis is good; it gradually lessens with age; it does no harm. The sexual neurasthenic of course looks upon it with horror, and for the mental relief of such persons treatment of the phosphaturia is required.

containing the second urine is held against the light and a few drops of acetic acid poured down its side. If phosphates are present, there follows instant effervescence (from the breaking up of carbonates that are always associated with phosphates) and clearing of the urine.

This clearing may be interfered with in only two ways, viz.: by the presence in the urine of insoluble substances, crystalline or organized, the nature of which must be determined by microscopic analysis, and by the presence of copaiba in the urine. The urine of a phosphaturic patient taking copaiba clears only for an instant, and then becomes cloudy again, the copaibal cloud being only a little less opalescent than the phosphatic cloud which it replaces.

When, therefore, we know from previous microscopic analysis the nature of the insoluble substances in a patient's urine, and know, also, that he is not taking copaiba, the acetic acid test is used as the simplest method of removing a chance phosphatic cloud, as a routine preliminary to the clinical examination of the urine.

Comparison of the First and Second Urines.—Having tested for phosphates by the addition of a few drops of acetic acid, and dissolved these, if present, by adding an excess of this acid, the physician holds the two glasses into which the patient has passed his urine against the light and compares their contents.[3]

The first urine passed is the urine as it lay in the bladder plus what it has swept from the urethral walls.

The second urine passed is the urine as it lay in the bladder, without admixture of anything gathered from the urethra during its exit.[4]

This rule has two exceptions, as follows: (1) If the insoluble substances suspended in the bladder urine are very dense they may settle to the bottom as the urine lies in the bladder and come away chiefly with the last drops of urine. The substances which fall within this exception are blood-clots, crystals (usually phosphates), and pus, when present in great quantity (such as usually comes from pyonephrosis).

(2) The second urine may also be contaminated by whatever may be squeezed from the urethral wall during the "piston stroke" muscular spasm

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First, one should insist that the phosphaturia is harmless in itself and only a sign of functional derangement. Secondly, one must insist upon a strict régime of diet and exercise appropriate to the existing nervous or digestive disturbance. Thirdly, one must remember that a direct attack upon the phosphaturia by drugs is usually a failure, and if successful is only of temporary efficacy. Hexamethylenamin, salol, benzoate of soda, and other urinary acidifiers have a reputation beyond their merits. Ten or fifteen grains of ammonium chlorid after each meal I have found more efficacious than anything else, but the main reliance is hygiene, especially as to diet and exercise.

[3] Comparative examination of the two urines is of no interest if the patient is a woman since the differences in them are chiefly accounted for by the vaginal secretion in the first glass. Examination of a third glass is equally inapplicable to women.

[4] This elementary physical fact that the first fluid flushes the outlet and the second comes clean from the tank would scarcely require explanation were it not for the fact that so many physicians believe that the first urine passed shows the contents of the anterior urethra, the second those of the posterior urethra.

that clears the urethra of the last drops of urine. Under this exception come pus squeezed from the prostatic ducts—or from a prostatic abscess—when the prostate is gravely inflamed, and blood squeezed from the bladder neck—or from the adjoining surface of the bladder or urethra—when this is acutely inflamed, ulcerated, or the seat of neoplasm.

These exceptions amount clinically to this:

The two-glass test may mislead in the presence of bleeding or of active suppuration in prostate or kidney.

The Three-Glass Test.—For such cases, a still further hint (none of these tests is a proof) as to the conditions present may be obtained by making the patient pass his urine in three glasses instead of two without interrupting the flow of urine in transferring from one glass to another. The three specimens thus obtained represent:

1. Bladder urine (less sediment), plus washings of urethra
2. Bladder urine (less sediment)
3. Bladder urine, plus sediment or substances expressed by "piston stroke"

Yet this test is very rarely employed, since its disclosures are confusing, because of failure to determine the derivation of the contents of the third glass, and require verification by other methods of examining the prostate, bladder, and kidneys, which methods are themselves far more accurate than this three-glass test.

Another three-glass test frequently employed as an aid in the diagnosis of chronic prostatitis or vesiculitis is the following: The patient urinates into two glasses, but retains some urine in the bladder The physician then massages the prostate or the vesicles, or both, and the patient then passes into a third glass the remaining urine, carrying with it the expressed secretion from the glands massaged.

This test is accurate only in case the second urine is quite clear, and is necessary only when it is impossible to squeeze from the suspected gland enough secretion to make it appear at the meatus, and when the instrumentation necessary to fill the bladder before massage is impracticable.

Other Tests.—A variety of tests involving the use of a greater number of glasses have been devised for the specific purpose of locating inflammation in the anterior or posterior urethra exclusively. Their complexity is such that they are of no practical value.

The Essence of Clinical Urinalysis

The results to be expected from any of these methods of clinical urinalysis are directly proportionate to the skill of the examiner. The essence of the test is his ability to distinguish at a glance slight variations in the amount and quality of pus, blood, or shreds present. Thus clinical urinalysis is of the greatest use for the prognosis from day to day. As a diagnostic test of the nature of disease it is at its weakest.

CHAPTER III

URETHRAL INSTRUMENTS: THEIR ASEPSIS

URETHRAL INSTRUMENTS

The axiom that a good workman does not complain of his tools implies in him appreciation and possession of adequate instruments. The urologist, therefore, must thoroughly understand the nature, the care, and the use of urethral instruments.

In the selection of urethral instruments no two authorities can be expected to agree. Thus the specialist can afford to employ many instruments which would be useless in less expert hands. But certain instruments are required by every man wishing to do good urological work. These we believe to be included in the following list. The list may be enlarged according to the fancy of the physician; on the other hand, it may be diminished by omitting the instruments bracketed.

A set of conical sounds (Nos. 15 to 32 French)
A set of olivary-tipped conical woven bougies (Nos. 10 to 20 French)
A set of bulbous bougies (Nos. 22 to 30 French)
Kollmann dilators
[Filiform bougies]
[A set of tunneled sounds and catheters]
A set of Janet steel sounds and Philips bougies (Nos. 10 to 20 French) and catheters with filiforms
Soft-rubber catheters
Woven olivary "natural curve" catheters
Indwelling flute-tipped catheters (Nos. 14 to 24 French)
An obturator to introduce rubber catheters
Urethroscopes and attachments
Cystoscopes, ureteral catheters, etc.
A 100 c.c. bulb syringe
Urethral bulb syringes
An instillator (Keyes, Bangs or Guyon type)
[Nozzles and apparatus for anterior urethral irrigation]

Scales

The scale for grading the caliber of urethral instruments was first accurately fixed in France, where two scales are at present in use—the Charrière—com-

monly known as the French scale—and the Béniqué. Other scales are the English and the American.

Of late years the tendency in this country, as well as in England, has been to adopt the French scale as the most convenient, while in France itself there is a tendency to replace the old French (Charrière) by the new Béniqué scale. Although Van Buren, senior author of the parent edition of this work, was very tenacious of the American scale—which, indeed, was born in his office—the almost universal adoption of the French scale since his time has led us to drop the American in favor of the French scale.

The French (Charrière) scale indicates diameters in ⅓ mm. No. 1 has a diameter of ⅓ mm., No. 2 a diameter of ⅔ mm., and so on. From this scale, therefore, the diameter of an instrument may be determined by dividing its number by 3. A No. 30 sound has a diameter of 10 mm.

The Béniqué scale indicates diameters in ⅙ mm. It numbers instruments twice as high as the Charrière. A No. 30 French sound is a No. 60 Béniqué. B. = F. × 2.

The American scale indicates diameters in ½ mm. 30 F. = 60 B. = 20 A. A. = ⅔ F.

The English scale follows no rule, but its numbers are generally about 2 less than the American. Thus, 30 F. = 60 B. = 20 A. = 18 E. E = (A. or ⅔ F.) — 2.

Sounds and Bougies

A metal instrument for urethral exploration is commonly termed a *sound*, though a bulbous bougie may be metallic, while a flexible instrument, made of woven silk or linen and varnished, is called a bougie.

The best woven instruments are made in France. In order to spare the patient's meatus, I have all my sounds above 24 F. size made with double taper (Fig. 1).

Sounds.—American custom favors the use of the single-curve sound (Fig. 1), while European custom favors the double-curve or Béniqué instrument (Fig. 6). After many years' use of the former, I have discarded them in favor of the latter. Above 24 F. sounds should have a double taper to spare the meatus more than a momentary stretching.

Conical Woven Bougies (Fig. 2).—These should be olivary tipped. In as much as they are used to dilate strictures up to the point where steel sounds may be used, one should possess a complete set from 10 to 20 F. size. The neck of the instrument should be quite flexible.

Bulbous Bougies (Fig. 3).—Bulbous bougies may be flexible or metallic. The best French makes of flexible bougies are almost as durable as metallic instruments.

Kollmann Dilators (Fig. 4).—These are useful for dilating the urethra while sparing the patient the insignificant operation of meatotomy, and also to

carry dilatation to great lengths. The Oberlaender, Frank, and Thompson dilators are inferior to the Kollmann. The best models of these dilators are rust proof. They are made in several designs, some of which have irrigat-

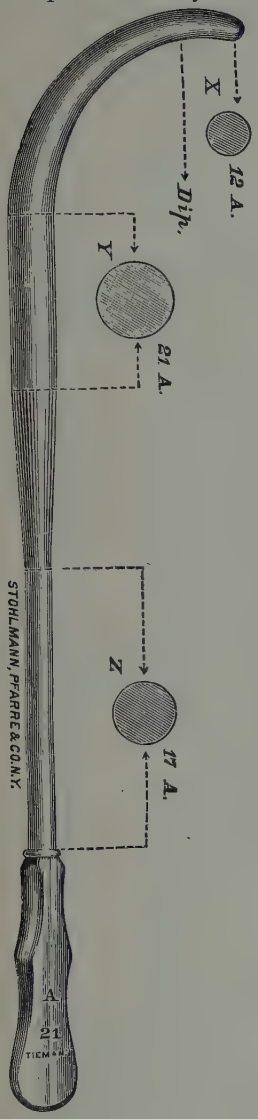


Fig. 1.—Double Taper Sound

Fig. 2.—Olivary Bougie

Fig. 3.—Bulbous Bougie

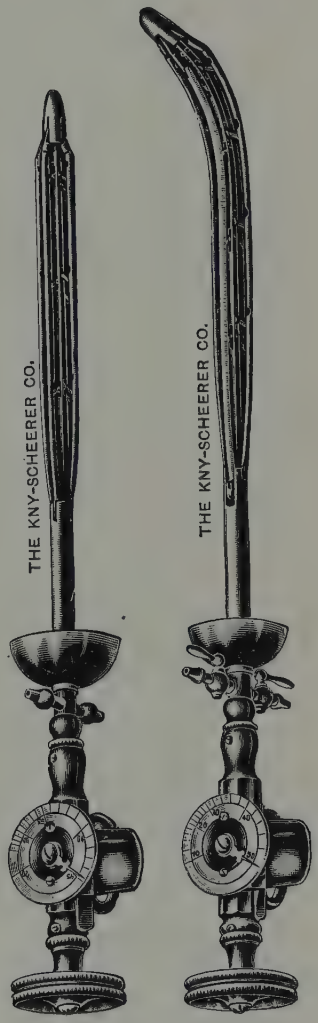


Fig. 4.—Kollmann Dilators

ing attachments. The two types illustrated are the ones generally employed, the straight for anterior, the curved for posterior urethra.

Filiform Bougies (Fig. 5).—Filiform bougies are made of whalebone or of woven silk. Their average size is 3 F.; they should be olive tipped. They are liable to break off in the urethra.

In as much as filiforms are used chiefly as pathfinders for larger instruments, the choice of filiforms depends largely upon the instruments which are to follow. Two combinations are possible, viz.: the whalebone filiform and the tunneled sound, the French woven filiform and the Janet sound (Fig. 6) or the Philips bougie or catheter. The latter is preferable.

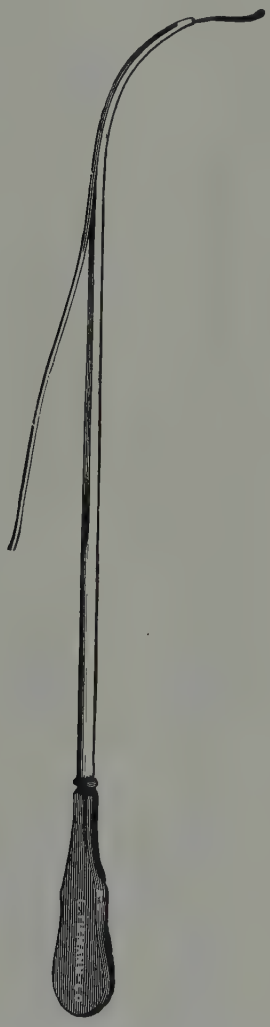


Fig. 5.—Whalebone Filiform and Tunneled Sound

Fig. 6.—Woven Filiform and Janet Sound

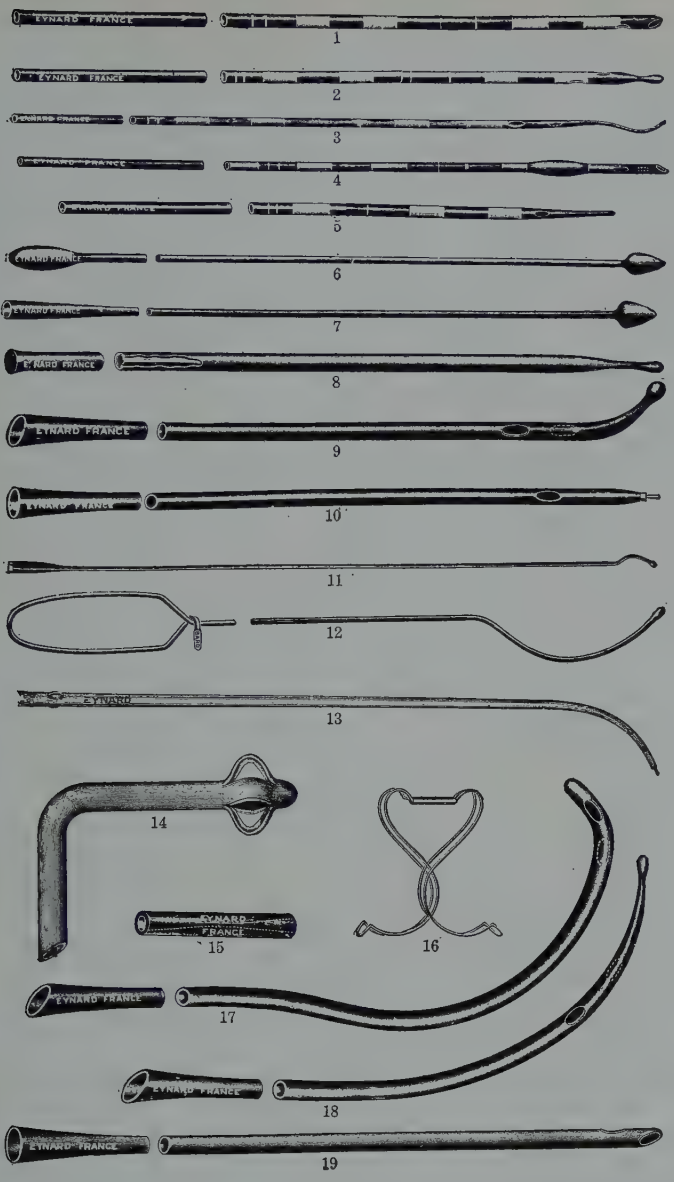
Catheters

A good catheter must be smooth both inside and out, boilable and durable.

Soft-Rubber Catheters.—These commend themselves for general use by their flexibility. Of all urethral instruments they can be passed the most

PLATE II.—VARIOUS URETHRAL AND URETERAL INSTRUMENTS.

1. Ureter catheter, flute tip
2. Ureter catheter, olivary tip
3. Ureter catheter (Blasucci), filiform tip
4. Ureter catheter (Braasch), with bulb for dilatation
5. Ureter catheter (Kelly), conical tip
6. Bulbous bougie
7. Guyon instillator
8. Urethral lead core bougie
9. Urethral catheter (Pasteau), elbowed olivary tip
10. Urethral Philips catheter
11. Philips bougie with elbowed tip
12. Obturator with Guyon curve
13. Le Fort metal urethral catheter (to be screwed to a filiform)
14. Malecot four-wing rubber suprapubic tube
15. Ureter catheter rubber adapter
16. Urethral clip (Zipser)
17. Woven urethral catheter, Guyon curve elbowed
18. Woven urethral catheter, "natural curve"
19. Rubber catheter, whistle tip (indwelling catheter)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gently. The choice of sizes lies between 14 and 16 F., except for indwelling catheters. These may profitably be used as large as 24 F.

Woven Olivary Catheters.—These are useful to penetrate a small orifice, as in case of stricture or spasm, while *woven elbowed catheters* introduced with the point directed upward, ride over obstacles on the urethral floor, as false passage or hypertrophied prostate. *Woven olive-tipped elbowed catheters* (Plate II, Fig. 9) combine the advantages of the olivary and elbowed instruments, and are more generally useful than either. But sometimes a spasmodic or congested urethra admits a blunt instrument more readily than an olive-tipped one, just as occasionally a straight instrument may pass where an elbowed one will not. *"Natural curve" catheters* (Plate II, Figs. 17, 18) are more generally useful than any other type of woven catheters. I employ them almost exclusively.

Indwelling Catheters.—These should be of rubber and flute tipped. The woven catheter is unsuitable since the urethral secretions dissolve the varnish upon them. The visible (or x-ray) catheter retains its varnish relatively well and should always be used for indwelling ureter catheterization.

Syringes and Nozzles

Bulb syringes have quite replaced piston syringes, except for the purpose of sucking clots from the bladder.

Instillators.—Instillators of the Keyes[1] pattern (Fig. 7), as at present constructed, consist essentially of small-caliber, short-curve silver catheters, with the eye in the tip. These are fitted to slip on a glass hypodermic syringe.

FIG. 7.—KEYES INSTILLATOR

The instruments are thus readily sterilized and portable. The straight part of the shaft should be 6 inches long, in order to keep its outer end clear of the glans penis.

Anterior Urethral Irrigation.—*The apparatus for anterior urethral irrigation* consists of a tank (preferably of glass, and so hung that it may be readily raised and lowered), a connecting tube, a nozzle, and means of interrupting the flow of fluid through the tube.

Of nozzles and interrupters there is a great variety. The simple, blunt-

[1] The Ultzmann syringe, of which the Keyes is a modification, is a very clumsy instrument. The Guyon instillator, a capillary woven catheter, has never found favor in this country. Modifications of the Keyes instrument have been made by Cabot, Bangs, and others.

pointed glass nozzle and a cut-off with protecting bell, form the most familiar apparatus. Many urologists employ a bulb syringe instead of this special equipment.

ASEPSIS IN URETHRAL EXAMINATION

However infected the bladder into which a catheter or sound is to enter, that catheter must be scrupulously aseptic. The days when surgeons may joke about the old gentleman who keeps his catheter inside his hat and spits on it by way of lubrication are past.[2] Even when the bladder is infected asepsis is imperative, to prevent an increase of that infection.

The asepsis of catheterism, using the term broadly to cover every passage of an instrument into the urethra, implies three requirements, viz.:

1. Asepsis of the physician's hands
2. Antisepsis of the patient's urethra
3. Asepsis of the instrument introduced

Asepsis of the Physician's Hands

It is not possible to require of the physician about to pass a catheter that he sterilize his hands as if for a surgical operation, or wear sterile rubber gloves. Such cleanliness is only required for such prolonged and delicate operations as cystoscopy. But the physician's hands should be well washed with soap and water, and, *having washed his hands, the physician should act as though they were still dirty; i.e.,* he should not touch that part of the instrument that is to enter the deep urethra. This is a simple rule, a necessary rule, a universal rule. *The last 3 inches of the instrument should not be touched by anything except sterilized lubricant from the time it is sterilized until it enters the urethra.*

Antisepsis of the Patient's Urethra

The Uninflamed Urethra.—It has been amply proven that, though the posterior urethra is sterile, the normal anterior urethra may harbor quite an indefinite number and variety of pathogenic microörganisms. But, on account of the mechanical cleansing of the urinary stream, these are almost exclusively confined to the balanitic portion of the canal. It is unusual to find bacteria in the bulb of the uninflamed urethra, though it is most unusual not to find them in the terminal inch.

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[2] Yet such old gentlemen are still encountered in practice. But the apparent immunity which some of them enjoy is due in part to the fact that their bladders are already so severely infected that a little saliva makes them no worse. And though their immunity may for a time prevail, in the end they become more and more infected and die of sepsis. The need for scrupulous asepsis is not because every dirty catheterism causes infection, but because a single dirty catheterism *may* cause infection of the gravest sort.

Moreover, the preputial cavity swarms with bacteria. Hence has arisen the practice of washing the glans penis with alcohol and flushing the terminal inch of the urethra with boric acid solution before introducing any instrument. Though such washing and flushing is scarcely more effective than that of the urinary stream, and might, therefore, be omitted, except in case the danger of infection is unusually great, *i.e.*, in cystoscopy, catheterism for aseptic retention, and tying in an indwelling catheter, perfect technic requires that this washing and flushing always precede introduction of urethral instruments of whatever description.

The Inflamed Urethra.—When the urethra is acutely inflamed, the passage of instruments is permissible only for the cure of that inflammation, or for the relief of retention of urine. In either event the mechanical damage done by any added manipulations outweighs their virtue. No special effort should therefore be made to clean the canal; the glans and meatus should be washed with alcohol.

Chronic urethritis is no bar to the passage of instruments. These may be used either for the treatment of urethritis or for the diagnosis or treatment of coexisting conditions.

In the former case the instrumentation (catheterism) habitually carries with it its own antisepsis (injection).

In the latter event (passage of sound, cystoscope, etc.), not only may this instrumentation not directly imply antisepsis, but it may directly imply considerable trauma to an infected canal. Therefore it is necessary to precede the instrumentation by a soap-and-water and alcohol wash of the glans and adjoining tissues, and a thorough irrigation of the whole urethra, with acriflavin 1:4,000, or oxycyanid of mercury 1:10,000. But the urologist must not confide too much in what is at best but a superficial and incomplete antisepsis of the urethra. The danger of infection is far more closely related to clumsiness or roughness in passing the instrument than to preliminary urethral antisepsis. *Every surgical operation must be cleanly; but every urethral manipulation must also, and above all, be gentle.*

The dangers of urethral instrumentation are local—exacerbation of urethritis, prostatic or periurethral abscess—and chiefly to be avoided by discretion in the choice of and gentleness in the passage of the instrument; or general —urethral chill, systemic gonorrhea, urinary septicemia—and chiefly to be avoided by antisepsis, and by gentleness. Let us not argue which is the more important. Both are essential.

This antisepsis, of which the principles and practice are discussed elsewhere, consists in: (1) Hexamethylenamin before, (2) gentleness during, and (3) local antisepsis after instrumentation.

The hexamethylenamin may often be omitted with impunity, and since it implies administration of the drug for forty-eight hours before instrumentation, it is often neglected. But there is no excuse for neglecting to be gentle or for omitting some form of antisepsis after instrumentation. Even when the

temper of the urethra is well known the omission of a postinstrumental antisepsis may unexpectedly permit a sharp chill.

The usual postinstrumental antisepsis consists of an injection of nitrate of silver or acriflavin or an irrigation with permanganate of potassium.

Asepsis of the Instrument

In any case, the instrument introduced must be aseptic. By this we mean that the whole instrument must be rendered aseptic,[3] and must so remain except for its contact with the physician's hands, which, as already stated, should not touch its terminal 3 inches.

This asepsis implies three conditions:

1. Aseptic lubrication
2. Antisepsis immediately before or after using
3. Aseptic preservation

The lubricant employed for urethral instruments should be soluble in water. Oily lubricants, such as vaselin or olive oil, may be perfectly sterilized by boiling, but they can only be removed from the instrument with great difficulty, if at all. Hence, an instrument covered by an oily lubricant is much more difficult to resterilize than one which is mechanically clean. Albarran has shown that a clean catheter may be sterilized by boiling for ten minutes, while an oily catheter must be boiled half an hour.

Among the substances in common use as lubricants may be mentioned glycerin and boroglycerid. Guyon uses a mixture of equal parts of water, glycerin, and soap powder. Various combinations of Iceland moss, sterilized in formalin, are sold under different trade names.

The Instrument.—The practice of asepsis for urethral instruments is approximately that of general surgery, and requires that:

1. The instrument should be so constructed as to be readily cleansed. It should be as free as possible from joints, crannies, etc. It should be in good condition, free from rust or cracks.

2. It should be sterilized by boiling. Metal instruments should be of stainless steel. *When a woven instrument is boiled, its varnish becomes soft, and therefore cracks if any other instrument rests upon it, or if it is bent before it has cooled.* Therefore it must lie perfectly straight in the sterilizer, touching neither the sides nor the ends of this, and with no other instrument resting upon it. More important still, *after the instrument has been boiled it must not be touched* until it has been cooled off, either by lifting it from the water on an automatic platform or by pouring in cold sterilized water.[4]

[3] The flaming of a metal instrument whereby the beak and shaft are sterilized, but the dirty handle remains uncleansed would be perfectly permissible were it not a dangerous habit to permit the least relaxation of asepsis. Moreover, the convenience of flaming compared to boiling is quite imaginary.

[4] Krotoszyner suggests a saturated solution of ammonium sulphate for woven instruments.

3. It should be washed clean and sterilized immediately after using, kept sterile, and resterilized immediately before using.

4. Instruments for use in "pus cases" should be kept entirely distinct from those for use upon "clean cases."

Unfortunately the one instrument that is the least subject to any of these rules, viz., the cystoscope, is the very instrument that preëminently requires sterilization. The special measures required for sterilization of cystoscopes are considered in Chapter VI.

All other instruments should be subjected to the following:

1. Soap and water wash, inside and out, immediately after using. Then rinse in water and boil for fifteen minutes.

2. Keep the instruments in an instrument case, the interior of which is kept at least relatively antiseptic by formalin (trioxymethylene) pastilles, or a formalin lamp.

3. Unless the instrument has been recently used and its asepsis assured, resterilize by boiling for fifteen minutes immediately before using.

CHAPTER IV

THE PASSAGE OF URETHRAL INSTRUMENTS

The successful introduction of an instrument into the urethra depends upon the skill of the operator and his comprehension of the obstacles that may defeat the operation.

ANATOMY OF THE URETHRA

The urethra is the outlet of the bladder. It commences at the bladder neck, but embryologically and anatomically that part of the floor of the bladder known as the trigone—*i.e.*, the triangular space between the orifices of the ureters and the urethra—belongs to the urethra, and will be so considered.

The urethra tunnels the upper part of the prostate, perforates the triangular ligament, and terminates at the end of the penis. Its outer opening is known as the meatus urinarius. The urethra is divided into two parts, the anterior and the posterior urethra, by the triangular ligament, the anterior urethra lying external to the anterior layer of that structure, and the posterior urethra being the continuation of the canal backward into the bladder. The anterior or spongy portion of the urethra is again subdivided into four parts, the navicular (or the fossa navicularis), penile, scrotal, and bulbous or bulboperineal. The posterior urethra is subdivided into the membranous, the prostatic, and the trigonal portions. It is much more accurate to speak of a lesion, such as a foreign body or a stricture, as being at the penoscrotal angle or in the bulb, than to say it lies at a depth of 4 or 6 inches, for not only does the length of the urethra vary according as the penis is erect or flaccid and in disease, as in enlargement of the prostate, but the urethral length varies widely in different healthy individuals. The urethra is always a collapsed canal throughout its whole course, except when distended by some substance or fluid.

The mucous membrane of the urethra consists of layers of epithelium, of which the superficial cells are squamous in the navicular and prostatic regions and columnar elsewhere, on a connective-tissue basement substance particularly rich in elastic fibers to allow for the great distensibility of the canal.

The Anterior Urethra

In the anterior urethra the mucous membrane is surrounded, except in the fossa navicularis, by a very thin longitudinal layer of unstriped muscle-fibers (in direct continuity with the inner fibers of the prostate), and these are in

turn surrounded by a very thin circular layer of unstriped muscle. These circular fibers are so few around the spongy urethra that their very existence was denied by Sappey. Finally, the anterior urethra is surrounded from triangular ligament to meatus by the corpus spongiosum, except for the centimeter nearest the bladder, where the corpus spongiosum fails to cover the roof of the urethra and is enlarged below into the bulb.

Crypts and Glands.[1]—In the roof of the fossa navicularis lies the lacuna magna, a simple pocket in the mucous membrane with its orifice toward the meatus, and consequently open to entrap small instruments. This lacuna varies greatly in size in different persons, being sometimes entirely absent, and occasionally running as far back as the triangular ligament, forming the so-called double urethra. Smaller lacunæ, usually ten or twelve in number, lie

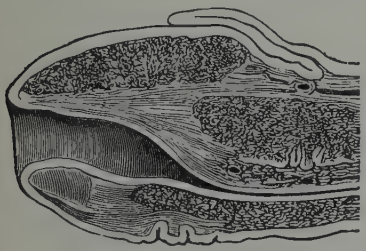

FIG. 8.—SAGITTAL SECTION THROUGH GLANS AND FOSSA NAVICULARIS

FIG. 9.—TRANSVERSE SECTION OF THE PENIS. (Cruveilhier)

along the roof of the penile urethra in one or two rows. Their length varies from 3 to 10 mm.

Cowper's glands are two small, round, lobular bodies, each about the size of a cherry stone, lying just behind the bulb of the urethra in the muscle between the layers of the triangular ligament. Their ducts open on the floor of the bulbous urethra.

The color of the urethral membrane is pale pink. At rest its walls are in contact, obliterating the cavity of the canal, so that a cross section presents a transverse slit (Fig. 9).

The anterior urethra is called the external urinary tract, and the canals and reservoirs beyond are the internal urinary tract, for the anterior urethra is in free communication with the surface of the body and harbors all the micro-organisms that may lie thereon.

The Posterior Urethra

The posterior urethra, extending from the anterior layer of the triangular ligament to the bladder, presents many notable points of contrast with the anterior urethra. The canal is no longer surrounded by erectile tissue, and,

[1] Johnson, *J. Urol.*, 1920, iv, 447.

indeed, it could scarcely become erect, for whereas the anterior urethra is freely movable with the penis, the posterior urethra possesses a fixed curve. Moreover, the posterior urethra is, in its normal state, entirely free from the bacteria harbored by the anterior urethra; it is the lowest section of the aseptic internal urinary tract.

The posterior urethra is divided into the membranous and the prostatic urethra, and the trigone of the bladder.

Of all parts of the canal the membranous urethra is the most fixed, running, as it does, from the aperture in the anterior layer of the triangular ligament to the aperture in the posterior layer. Its mucous membrane, though of a darker color and much more sensitive, does not differ in structure from that of the anterior urethra. This in turn is surrounded by a thin layer of unstriped muscle, but instead of being sheathed in the corpus spongiosum, it is embedded in the voluntary muscle that fills the space between the two layers of the triangular ligament. This muscle has had special names given to different portions of it by Guthrie, Müller, Wilson, and others, but it may be considered clinically as one muscle, the constrictor or compressor urethræ, the cut-off muscle, the external or voluntary sphincter of the bladder. The last term best expresses its function. It is the muscle by which the outflow of urine from the bladder is voluntarily opposed. It may suffer from spasm, and so not only prevent urination, but also present a serious obstacle to the introduction of instruments. This is spasmodic stricture.

The roof of the membranous urethra is perforated by small glands similar to those found in the anterior urethra.

The prostatic urethra tunnels the prostate, sometimes barely covered by that organ above, sometimes deeply embedded in it. It is fixed only where it joins the membranous urethra. It is fusiform in shape, being closed internally by the internal or involuntary sphincter of the bladder. Into it the ducts of the sexual organs empty. It is lined by squamous epithelium like that of the bladder, and is liable to great deformity and obstruction by prostatism. Upon its floor rises a little mass of erectile tissue, the verumontanum, or caput gallinaginis, the anterior slope of which is hollowed out into a little cavity, the sinus pocularis or utricle. The prostatic ducts open upon the floor of the urethra on each side of the verumontanum. The ejaculatory ducts usually open on the edges of the sinus pocularis.

The urinary tract, like the intestinal tract, possesses two sphincters, an internal sphincter of unstriped muscle and an external sphincter of striped muscle-fiber.

The external or voluntary sphincter is the constrictor or compressor urethræ, mentioned above. It surrounds the membranous urethra almost to the apex of the prostate. On the upper surface of the urethra the fibers of the compressor continue back for a centimeter or more over the anterior surface of the prostate.

The trigone, *i.e.*, the triangular portion of the bladder floor lying between

the orifices of the urethra and the ureters, is developed from the ureteral muscle. It is mesodermic in origin, while the vault of the bladder is derived from the entoderm of the allantois. Young and Wesson [2] have shown that there is no true internal sphincter of the bladder. The trigonal muscle converges from the ureters to the urethra, superimposed upon the bladder muscle proper. At the urethral orifice a pseudosphincter is formed by two loops of bladder muscle, arising respectively from the inner and outer layers of bladder muscle. The trigonal muscle interlacing with these at the bladder neck, counteracts them, and by its contraction opens the bladder neck.

The mucous membrane contains papillæ and a few scattered glands, which do not occur in the bladder proper. The circulation of the lower ends of the ureters, the trigone, and the prostatic urethra is derived from the inferior

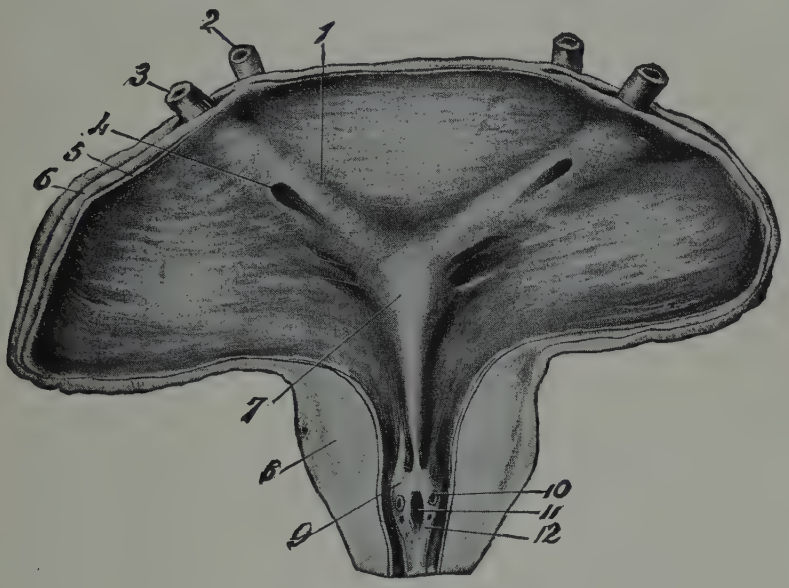

FIG. 10.—TRIGONE AND POSTERIOR URETHRA

1, Interureteric bar; 2, vas deferens; 3, ureter; 4, ureter mouth; 5, mucosa of bladder; 6, muscularis of bladder; 7, trigone; 8, prostate; 9, verumontanum; 10, orifice of ejaculatory duct; 11, utricle; 12, prostatic ducts. (Henle)

vesical artery. The lymphatics of the trigone are more numerous than they are elsewhere in the bladder, and are in direct communication with those of the posterior urethra.

Length.—The length of the urethra, varying as it does in different individuals and in the same individual with erection of the penis and enlargement of the prostate, may be set down as averaging 20.5 cm. (8¼ inches),[3] and varying in different normal individuals from 18 to 23 cm. (7¼ to 8¾

[2] *Arch. Surg.*, 1921, iii, 1.
[3] Keyes, *Am. J. M. Sc.*, 1898, cxvi, 125.

inches). The posterior urethra is usually 5.5 cm. (2¼ inches) long—2.5 cm. (1 inch) to the membranous portion, 3 cm. (1¼ inches) to the prostatic—and (1 inch) to the navicular region, 6.25 cm. (2½ inches) to the penile, 3 cm. (1¼ inches) to the scrotal, and 3 cm. (1¼ inches) to the bulboperineal.

Diameter.—The diameter of the normal urethra varies even more than the length. A fair average is not larger than 0.75 cm. (0.3 inch); about No. 27, French scale. But, whatever its size, the urethra is not a tube of uniform caliber from end to end. It has naturally four points of physiological narrowing: the first at the meatus, the second at the penonavicular junction, the third beginning about half an inch back of this, and becoming most pronounced at about the penoscrotal junction. The fourth and fifth constrictions are the voluntary sphincter (the entire membranous urethra) and the internal involuntary sphincter (the neck of the bladder). Of these five narrow points, three, it will be observed, are organic and situated in the anterior urethra, while the other two are muscular and situated in the posterior urethra. The muscular constrictions are widely dilatable, and the caliber of the canal is determined by the meatus, normally the narrowest point. Hence the caliber of the urethra is the caliber of its normal meatus. The penonavicular and penoscrotal constrictions are usually mere irregularities in the canal, besides which there are often lesser contractions at various points, making the urethra, when distended, not a smooth, evenly calibrated tube, but a very irregular one. The three chief *dilatations* of the normal canal are the fossa navicularis, which is situated just inside the meatus; the bulbous urethra, occupying a position immediately in front of the triangular ligament, and the prostatic urethra. Of these the second is the larger.

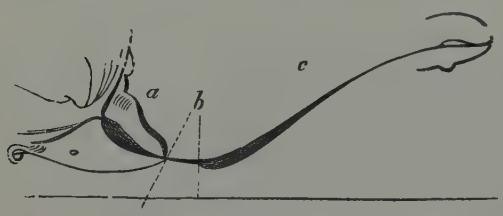

FIG. 11.—LONGITUDINAL SECTION OF URETHRA

a, *b*, and *c*, represent the prostatic, membranous, and spongy portions of the urethra. (Thompson)

Curve.—In relation to these variations of caliber Guyon's observations upon the relative qualities of the urethral roof and floor are of interest far more from a practical than from a theoretical point of view. His observations may be classified as follows:

1. The roof of the urethra, when the penis is erect, forms an uninterrupted curve from the fossa navicularis to the bladder.

2. All the variations of caliber, except the fossa navicularis, are produced at the expense of the floor, which is, in consequence, very irregular.

3. The mucous membrane of the roof is more closely adherent to the subjacent structures than that of the floor.

4. The mucous membrane of the floor of the urethra is much more elastic than that of the roof.

Therefore, not only is the floor of the urethra more irregular than the roof,

but its irregularities may be increased with much greater facility by any object introduced into the canal, as well as by disease. In other words, instruments, especially if small and rigid, may furrow the floor of the urethra with their points, until, finally, they become pocketed, usually in the bulb, and so are brought to a full stop, while an instrument whose point impinges always on the roof avoids these obstructions and glides easily into the bladder. Therefore, the roof is the surgical wall of the urethra, *i.e.*, the guide to instruments entering the bladder. Because fistulæ and false passages usually occur in the floor and lateral walls, and because the orifice of a stricture is generally nearer the roof than the floor, the roof is the surgical wall in disease even more than in health.

THE CURVE OF URETHRAL INSTRUMENTS

From these considerations it follows that *the curve of the urethra is the curve of its roof.* Now the entire anterior urethra is freely movable with the penis, and can be made to assume any curve. Not so the posterior canal. The membranous urethra, bound tightly at its extremities by the two layers of the triangular ligament, is the real fixed point of the urethra, and runs at a distance of from 1 to 2 cm. (⅖ to ⅘ inch) below the symphysis pubis. In front of this the bulbous urethra tends slightly upward because of the tension of the suspensory ligament, while a similar elevation is given to the prostatic urethra behind by the puboprostatic ligaments and the anterior fibers of the levator ani muscles. Thus is formed the so-called fixed curve of the urethra—not a true fixed curve, for by depression of the bulbous and the prostatic urethræ to the level of the membranous portion it can be, and often is, transformed into a straight line—as when straight metal instruments are introduced. The curve varies [4] slightly in different persons, and in the same person at different periods of life, being shorter and sharper in the child, longer in the old man. An enlarged prostate lengthens the curve.

The curve of the old-fashioned "prostatic" catheter was of a much larger

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[4] The proper average curve, as recognized by Sir Charles Bell and insisted on by Sir Henry Thompson and Van Buren—the one which will mathematically accord with the greatest number of urethræ—is that of a circle 8.125 cm. in diameter; and the proper length of arc of such a circle, to represent the subpubic curve, is that subtended by a chord 6.875 cm. long. An instrument made with a short curve of this sort will readily find its way through the normal urethra into the bladder without the employment of any force. It is very desirable that instruments intended for habitual use should be so constructed, inasmuch as many of the difficulties of catheterism are due to a defective curve in the instrument employed. The defect most frequently encountered is too great straightness of the last half inch—a deviation of the curve at its most important point. In an instrument properly made it will be found that a tangent to the axis of the curve at its extremity will intersect the projected axis of the shaft at a little less than a right angle. If the curve comprised only a quarter of the circle, the tangent would meet the projected shaft at a right angle; but instruments made a little longer, as they are usually found, often have the last part of the curve tilted off into a faulty direction, making the angle between a tangent to the axis of the curve at this point and the projected axis of the shaft obtuse.

radius than that described in the footnote. The "natural curve" catheters have a similar long wide curve. But this has no relation to the fixed curve of the urethra and is merely a convenient way of keeping the tip of the instrument constantly in contact with the urethral roof.

PHYSIOLOGY OF THE URETHRA

Sensibility.—Under normal conditions the sensibility of the anterior urethra is slight, although it is exquisitely sensitive when inflamed. The prostatic urethra may be excessively sensitive, while the membranous portion of the canal is always somewhat sensitive. Indeed, the first passage of an instrument through this part of the urethra of a nervous individual is attended not only by pain, but also by a decided shock. He becomes pale and nauseated, may even faint, if not already in a recumbent position; while the recorded deaths ensuing upon this simple maneuver, though few, attest its severity. This acute sensibility becomes rapidly deadened, unless the canal is inflamed, so that after a few repetitions the operation is attended by no shock and but little, if any, pain.

Mobility.—The *muscles* of the penis and urethra are thrown into action during urination or erection and emission, and their functions are therefore more fitly described under these titles. A few words concerning *the cut-off muscle* may not be amiss in this place. Besides its most important function of preventing the urine from escaping from the bladder by an effort of the will and of cutting off the stream, it presents several interesting physiological characteristics. The urethra in front of the cut-off muscle swarms with bacteria, while all beyond is germ-free. This is so, not because the muscle presents an impassable barrier, for it does not. Its periods of contraction, like those of the external sphincter ani—to which it bears a close resemblance—are comparatively infrequent and of short duration. Its normal tone, however, is sufficient to make the channel a narrow and difficult one, readily cleansed of any chance invader by the periodical outflow of urine. It is suggestive, moreover, that the cut-off muscle surrounds the most sensitive part of the urethra. Hence the cause of spasm in this muscle, whether acute from some local or general shock, or chronic as a specific evidence of a neurotic habit, is not far to seek.

TECHNIC OF THE PASSAGE OF SOFT INSTRUMENTS

The instruments are sterilized, the operator's hands washed and the meatus and glans cleansed, as described in Chapter III.

A patient being catheterized for the first time will appreciate the kindness of local anesthesia (10 per cent procain).

The object of lubricating a urethral instrument is *not to make the instrument slippery, but to let it slip through the meatus.* A small dab on each lip of the meatus is all that is needed, and this is best applied, not by greasing

the whole shaft of the instrument, but by transferring a bit of lubricant to its tip, and with it smearing the lips of the meatus.

The patient should lie flat upon his back for the first instrumentation, since this sometimes causes marked nervous shock. But for subsequent operations he may assume any convenient position.

The catheter is readily introduced as far as the bulbous urethra. Up to this point the urethra offers no obstruction, unless the meatus is unusually small. But unless the penis is held at right angles to the patient's body, the bend of the urethra at the point of attachment of the suspensory ligament, just back of the penoscrotal angle, offers a slight resistance.

At the junction of the bulbous and the membranous portions of the urethra the catheter encounters the compressor urethræ muscle. This muscle may present a scarcely perceptible obstacle or it may be excited to reflex spasm of such intensity as to prevent the entrance of the catheter.

It is proper to introduce sounds and other metal instruments into the urethra gently out of respect for the patient. It is necessary to introduce the softer instruments slowly in order to get them in. Rubber catheters guided by inexpert hands have a tendency to poke their noses into the pocket of the bulb and there remain. The reason for this is roughness. The tip of the instrument is pushed against the face of the cut-off muscle so rudely that this goes into spasm and deflects the tip down into the bulb.

The remedies are, first and always, gentleness; if this fails, anesthesia; and if this fails, the selection of an instrument whose tip will ride out of the bulb against the roof of the urethra and so make a more precise contact with the orifice of the cut-off muscle. Hence the various elbowed and curved instruments made of varnished cloth (Plate II, Figs. 9, 17, 18).

In order to introduce any of these instruments with the maximum of comfort and the minimum of trauma they should be passed so slowly that the least resistance is immediately recognized and surmounted, not by force, but by holding the instrument gently against the face of the obstacle until it is felt to give way. If this maneuver does not succeed, another instrument must be tried.

The expert may assist the passage of soft urethral instruments by gentle pressure with a finger against the perineum.

If the point of the instrument sticks in the prostatic urethra, it may often be disengaged by counterpressure with a finger in the rectum.

Method of Overcoming Spasm of the Compressor.—When the advance of the catheter is obstructed by the compressor urethræ, the tip of the instrument may lie just within the grasp of the outer fibers of this muscle or it may pass down into the pocket of the bulb.

The first maneuver to overcome this obstacle is to crowd the catheter gently but firmly into the urethra and hold it there for half a minute. On releasing the catheter it either springs back or remains in place. If it springs back it may be taken for granted that the tip of the instrument is pocketed in

the bulb, and does not present at the opening of the muscle; it must then be removed and another instrument selected. But if the catheter does not spring back it may again be crowded against the muscle in the hope that a slight advance has been made and that further pushing will finally overcome the spasm.

The second maneuver is to select an instrument that will present its point accurately at the orifice of the muscle and have sufficient rigidity to overcome the spasm. The best instrument for this purpose is the "natural curve" woven catheter. It usually slips readily into the posterior urethra.

The third maneuver is to aid the passage of the woven catheter by gentle pressure upon the floor of the bulbous urethra with a finger against the perineum, while with the other hand the catheter is gently pushed forward.

Method of Passing the Neck of the Bladder.—When a flexible catheter has passed the compressor muscle of a normal urethra, it usually enters the bladder without further difficulty. But if it stops we know that its point has caught in the floor of the prostatic urethra in front of the internal sphincter. It may be lifted out by pressure with a finger introduced into the rectum.

TECHNIC OF THE PASSAGE OF METAL INSTRUMENTS

After proper cleansing and anesthesia, the penis is held at right angles to the patient's body while the lips of the meatus are lubricated by a touch with the tip of the instrument.

1. The shaft of the instrument is held over the fold of the groin, its handle nearly in contact with the skin, from which latter (the integument, first of the groin and then of the abdomen) it is not to be removed until the point of the instrument is about to enter the membranous portion of the urethra.

2. The instrument, at first held along the groin, with point high and handle low (Fig. 12), is introduced at the meatus, and the penis molded up over it. It is not pushed into the urethra, but the urethra is made to swallow the instrument, as it were.

3. When the curve, and perhaps an inch of the shaft, have disappeared within the meatus, the handle of the instrument is swept around over the surface of the belly, so as to lie exactly over the linea alba, parallel with it, and still close to the integument.

4. The whole shaft of the instrument is now to be gently pressed toward the patient's feet, being still kept close to and parallel with the surface of the belly, the penis, meanwhile, being lightly grasped behind the corona glandis and held steady.

5. The point of the instrument may be followed with the little finger of the hand which manages the penis, and, when it gets fairly past the penoscrotal angle, the whole scrotum, with the testicles and penis, should be largely seized with the hand and pressed against the pubis, with slight upward traction (Fig. 13). The point may now be felt to settle down and adapt itself to the

subpubic curve, after which the weight of the instrument, properly directed, should carry it into the bladder.

6. As soon as the curve lies well against the symphysis, the scrotum, testicles, and penis should be dropped; the hand which held them takes the instrument, steadies it in the median line, and gradually carries the shaft away from the abdomen (Fig. 14), making the handle describe the arc of a circle, and depressing the shaft between the thighs until it lies nearly in the same plane with them. No pushing movement should be imparted to the instrument during

Fig. 12.—Introduction of Sound. I.

this time. The handle is made to describe the arc of a circle, and in a healthy urethra the point cannot go astray. While the instrument is being depressed between the thighs, the free hand is employed in pressing down upon the mons veneris and the root of the penis (Fig. 14), to stretch the suspensory ligament—a point of importance to the easy introduction of an instrument.

7. The instrument should be withdrawn with the same deliberation and care with which it is introduced. No traction is needed. The motions used in introduction are simply reversed. The handle of the instrument is lightly caught, and without traction made to describe the arc of a circle until it touches the abdomen over the linea alba. It is then carried around to the groin, and, by a tilting motion, unhooked from the urethra, ending exactly where it commenced along the groin, the handle low, the point high.

The first principle of instrumentation in the urethra is to avoid the use of force. Even in a healthy subject the beak of the instrument may become

pocketed in the floor of the urethra. It is to avoid this that upward traction on the scrotum and penis is made, whereby the beak of the instrument is held in contact with the roof of the urethra, the surgical wall, until it gently slides of its own weight into the bulb and impinges against the triangular ligament. Here the beak of the instrument naturally sinks into the sinus of the bulb, and ceases to advance. Now it is that the operator, by pressing downward the mons veneris, tilts the instrument so that its beak touches the roof of the canal, and slides gently into the membranous urethra, the cut-off muscle relax-

FIG. 13.—INTRODUCTION OF SOUND. II.

ing before it. But often the beak is not so readily liberated. That it is still caught in the bulb may be known by the bulging out of its curve in the perineum as the shaft is being depressed between the thighs, and by the rebound of the handle when liberated. The obstacle is overcome by gently maneuvering the point of the instrument, by partial withdrawal and reintroduction, or by slight depression of the beak, then lifting it over the obstacle with a finger in the perineum, at the same time pressing down upon the shaft of the instrument to make its point sweep the roof of the canal. The dangerous *tour de maître* [5] should never be tried, nor any force used in the manipulations at this point, as a false passage is easily made here and under these very circumstances. The depression of the handle of the instrument alone is capable of exerting

[5] The *tour de maître* consists in introducing a sound with the shaft between the patient's legs until the point is arrested at the bulb; then the handle is rapidly made to describe a semicircle until it reaches a vertical position, when it is at once depressed between the thighs. This is brilliant but dangerous.

enormous power. The sound represents a lever of the first order, and the surgeon has the long arm.

With a little patience a suitable instrument will always pass into the bladder unless there is a stricture. When the point has traversed the membranous urethra it must continue on freely if the prostate is normal.

The sound need only be introduced far enough to bring its greatest diameter into the membranous urethra. This is accomplished when the shaft has been depressed almost, but not quite, to the plane of the body. To pass it farther,

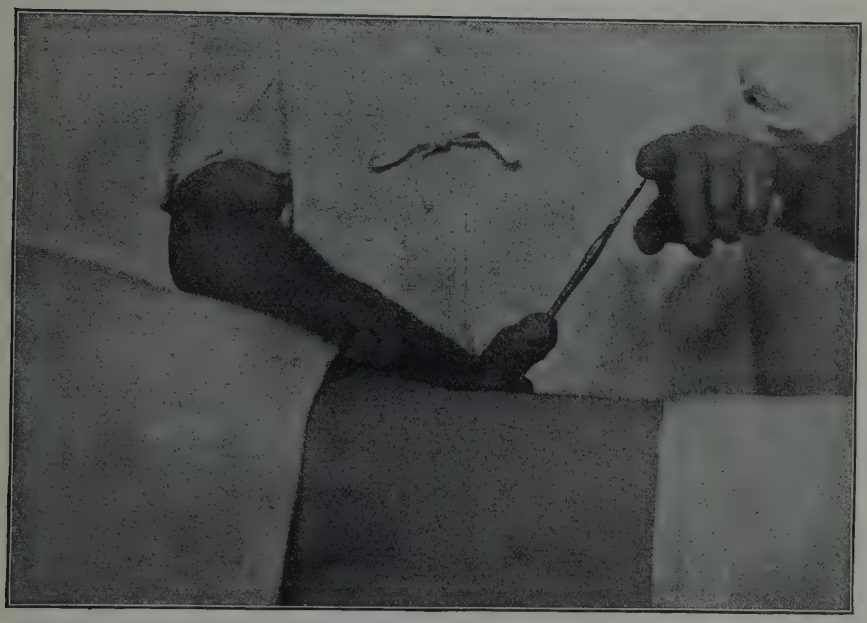

Fig. 14.—Introduction of Sound. III.

so as to straighten out the prostatic urethra, is unnecessary, painful, and, in certain cases, dangerous.

Instruments small enough to engage in the sinuses of Morgagni are not used in the healthy canal. Instrumentation in morbid conditions will be detailed in connection with the different diseases requiring it.

The *cystoscope* and the *stone searcher* are introduced in the manner above described; but the depression of the handle is carried far enough to permit the angle of the instrument to slip over the bladder neck, an occurrence signalized by a distinct jerk.

The sensation experienced by a healthy urethra is that of hot points pricking the canal along the part being traversed by the instrument. As this enters the membranous urethra, a desire to urinate begins to be felt, which increases as the prostate and the neck of the bladder become distended by the instrument, so that the patient sometimes believes the urine is flowing

away, in spite of the surgeon's assertions and his own observation to the contrary. Nausea, and even syncope, may occur as the instrument distends the prostate, especially on the first introduction in sensitive young people. Occasionally distention of the prostatic sinus produces erection.

If the patient faints, the instrument should be withdrawn at once and the legs elevated, while the head is hung over the edge of the lounge upon which he lies. The facility with which this may be done, if necessary, is one of the reasons for placing the patient on his back for his first catheterization.

The more serious *complications* of catheterization, such as false passages, urethral fever, etc., will be considered in the succeeding chapters. Ordinarily speaking, none of these complications need be expected to follow the gentle passage of a clean instrument into a urethra which is neither inflamed nor lacerated; but in order to avert the possibility of cystitis or chill it is safe to *terminate every catheterization or sounding by a forced injection into the whole urethra of acriflavin 1:5,000 or potassium permanganate 1:5,000,* unless some other solution is used as a part of the treatment, or the temper of the urethra is well known.

INJECTION OF THE URETHRA

The instrument employed is a small glass syringe with a bulb rather than a piston as motive power. An old soft bulb is much better than a new hard one that does not transmit to the operator's fingers the sense of resistance (Fig. 15).

The prepuce is retracted, the glans penis cleansed and its corona grasped between ring and middle fingers of the left hand, while with thumb and index the lips of the meatus are held apart for the nozzle of the syringe to be set snugly between them. Upon the precision with which this is done, and the

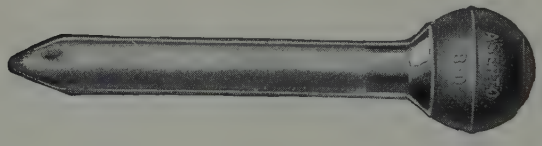

Fig. 15.—Bulb Urethral Syringe

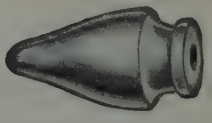

Fig. 16.—Urethral Adapter for Glass Syringe with Pointed Nozzle

correct pointing of the syringe, so that the fluid will readily enter the canal, depends the success of the operation. A tight joint between urethra and syringe is then made, not by lateral pressure, but by pressing the glans penis forward against the syringe with the fingers behind the glans, while the thumb and index have no other function than to steady the joint and after the injection has been made, to close the meatus by lateral pressure upon its lips.

If only the anterior urethra is to be injected the bulb is slowly compressed and the trick is done.

If the posterior urethra is to be injected the maneuver differs, depending on whether a small or a large quantity of fluid is to be employed. For local anesthesia we wish to inject only enough solution to cover the posterior urethra and trigone. About 5 c.c. suffice. When this has been injected, as just described, the meatus is compressed for about a minute to gain a slight anesthesia of the face of the cut-off muscle. While this is being done pressure on the bulb is released and the syringe full of air is applied to the meatus as before, care being taken to prevent the escape of whatever fluid is already in the urethra. This second charge is injected more slowly than the first and the injection so continued until the muscle is felt to give way and with a gurgle of air the anesthetic is forced into the posterior urethra.

Until the urologist has learned to do this without spilling a drop of fluid or drawing a drop of blood he has not proven his dexterity and gentleness. He is not really skillful until he can inject the fluid and stop short of injecting the air. Air embolism need not be feared unless the enthusiast is so stupid as not to recognize the gurgle that announces the arrival of air in the bladder. A man as clumsy as this had better be detected early and banished young.

The first attempt at forced irrigation of a large quantity of fluid is made as follows:

1. About 5 c.c. of 10 per cent novocain solution are gently injected into the anterior urethra and held there for at least five minutes. This is then released.

2. The patient, lying on his back, is instructed to relax his muscles, to rest his hands on his chest, to breathe with his mouth open, breathing gently. The operator fills a large bulb syringe (100 c.c. capacity) with the solution to be employed, applies a drop of lubricant to its nozzle and inserts this snugly but without force into the urethra as described above. He then (*a*) holds the penis against the syringe with his left hand, ring and little finger behind the corona pressing forward, thumb and index fingers on lips of meatus only pressing hard enough to steady the point of junction between the syringe and the urethra. (*b*) With the right thumb he very gently depresses the center of the bulb until he feels the resistance of the sphincter. Upon his gentleness at this moment depends the success of the operation. If he presses hard enough to excite pain and spasm, he will fail to enter the bladder. (*c*) Let him watch the patient's toes. They are the spasm meter. Before attempting to pass the sphincter be sure the ankles are relaxed. With the onset of urethral spasm up go the toes. Fix the patient's mind on his toes. If he keeps them down and lax the sphincter gradually opens and admits the fluid.

The first effort is a success if it admits 20 c.c. After a second or third attempt, with at least a day's interval between, any desired amount may be forced into the bladder. Then the preliminary anesthetic injection may be dispensed with.

In the clinic it is convenient to use an irrigating tank and a glass nozzle instead of the bulb syringe. The tank should be elevated 3 to 4 feet above the level of the patient's pelvis.

Many considerations govern the selection of forced or catheter injection of the posterior urethra and bladder. Among them are the following:

1. Any injection that makes the urethra bleed, it must be concluded, has been roughly or unintelligently given. Bleeding means a tear, an increase in the urethral lesion. The urethra that bleeds requires treatment by dilatation and injection by catheter.

2. A certain choice should be allotted to the patient. The docile patient usually does well under forced injections.

Fig. 17.—Female Urethral Syringe

3. Yet the catheter acts as a sound. The pressure it makes upon the urethral wall tends to heal its lesions.

4. When a course of injections is being given by force, the catheter should be used from time to time to be sure that there is no residual urine.

Injection of Female Urethra.—The female urethra and bladder may be injected with the blunt nozzle syringe. Figure 17 illustrates a syringe especially adapted to forced irrigation of the female urethra and bladder.

INSTILLATION

The object of instillation is to place upon a given portion of the urethra a drop or two of a solution so concentrated that it could not be used over an extended area or in large quantity.

The instillator is introduced like a sound or a woven catheter. In as much as the instillation is usually intended for the prostatic or the membranous urethra, one should have a clear idea of the precise position of the instrument as its tip enters the posterior urethra. The jump as it passes the external sphincter is often quite palpable; but in case of doubt one may always feel confident that when the instrument has reached a point in the urethra where its shaft rests without pressure at any angle between the perpendicular and the patient's feet, its point is in the membranous urethra (Figs. 18, 19). Beyond this the instrument should not be introduced. The fluid injected will bathe the deep urethra.

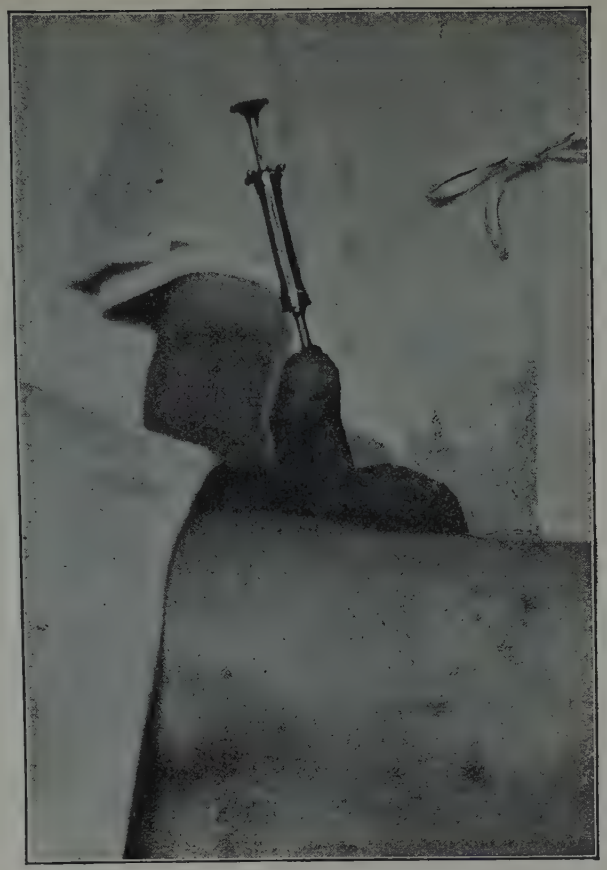

FIG. 18.—TIP OF INSTILLATOR IN BULBOUS URETHRA

FIG. 19.—TIP OF INSTILLATOR IN POSTERIOR URETHRA

CHAPTER V

URETHROSCOPY

The urethroscopes commonly employed in the United States to-day are the following:

1. The original straight open tube of Desormeaux with external illumination. This instrument goes under many names, but is usually sold as a Young urethroscope.

2. The straight tube closed at the outer end, with internal illumination and employed with water distention, such as the instruments of Geiringer (Fig. 20), Stern, Buerger and Greenberg.

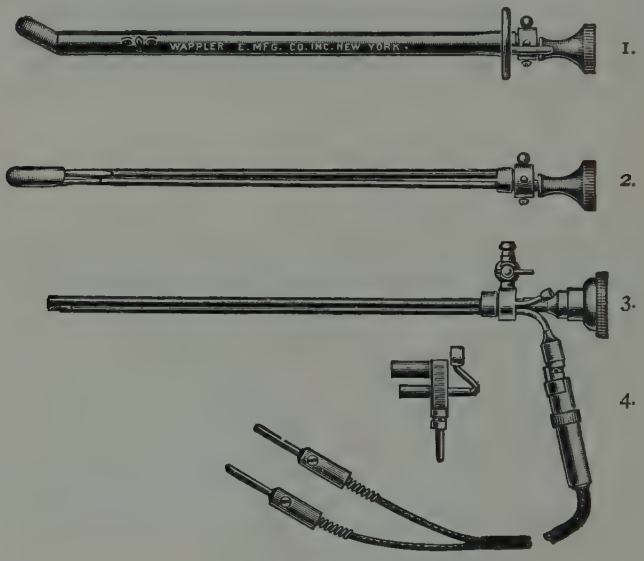

Fig. 20.—Geiringer Urethroscope

1, Sheath and obturator; 2, obturator; 3, telescope and wires; 4, lamp for anterior urethroscopy.

3. The panendoscope of McCarthy, vision deflected 45 degrees (Fig. 21).

I prefer the Stern to any other urethroscope, though I possess and use each of the above three types. In my own clinics, no two men seem to agree as to which is the best instrument. Doubtless, neither the urethroscope nor the human mind is, as yet, wholly perfected.

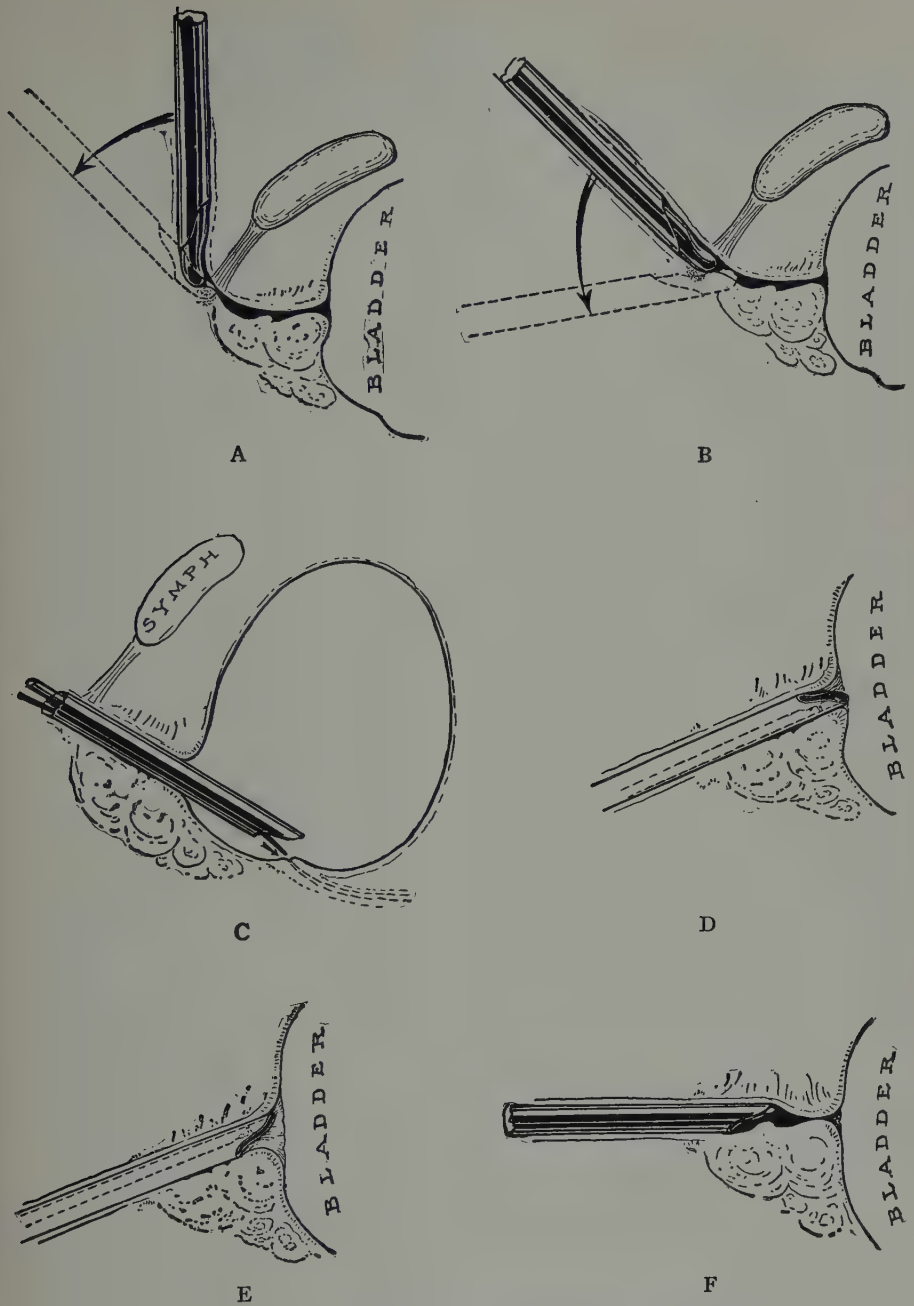

FIG. 21.—INTRODUCTION AND USES OF THE PANENDOSCOPE

A, at the bulb; B, entering posterior urethra; C, catheterizing ureter; D, inspecting roof of bladder neck; E, inspecting floor of bladder neck; F, inspecting veru. (Wappler)

DIAGNOSTIC URETHROSCOPY

Anterior Urethra.—*The straight open tube is used.* The patient is on a cystoscopic table. No anesthesia is required unless for meatotomy. The tube is lubricated, the glans penis cleaned, the tube introduced, directed downward until it will go no further, then it is gradually inclined to an angle of 60 degrees or more. The operator then steadies the tube with his left hand; the forearm steadying itself against the patient's body. The obturator is then removed with a gentle rotary movement to disturb the tube as little as possible. The source of illumination is then affixed and one looks for the orifice of the membranous urethra. Usually the tube has not been bent over far enough; one sees only the floor of the bulb. By rotating the tube still further downward the puckered lumen comes into view; then the tube is slowly withdrawn, at such an angle as to keep the lumen of the canal in the center of the field of vision.

The tube is slowly withdrawn, all parts of the canal being inspected as they pass under the eye; blood, pus or lubricant is mopped away with a cotton swab on a wooden applicator.

Normal Anterior Urethra.—The walls of the urethra fall together over the end of the tube to make a hollow cone. The mucous membrane varies in color from pale to salmon pink. The absence of inflammation is evinced by the suppleness of the walls of the canal which fall together in longitudinal folds from four to twelve in number, radiating from the center to the circumference of the field; between these folds the pink mucosa is lined by longitudinal deep red striæ. Upon the roof of the urethra, and less frequently upon its floor, the crypts appear as deep red indentations, the normal ducts of the glands being invisible.

In the bulb the lumen of the urethra forms a lateral slit; openings of Cowper's ducts upon the floor of the bulb are usually concealed by a fold of mucous membrane.

The navicular urethra is pale and rigid; the lumen is a vertical slit; there are no folds or striæ; the opening of the lacuna magna is seen upon the roof.

The Inflamed Anterior Urethra.—When subacutely inflamed the surface is red and velvety. The gloss and the brilliant red striæ are lost. The swelling of the mucous membrane reduces the number of longitudinal folds. Patulous crypt orifices are seen exuding pus.

Mild chronic anterior urethritis, a soft infiltration, shows much the same picture. The redness is not so marked, the luster of the surface may be increased, but the striæ are lost, the folds reduced, the crypts red, patulous, purulent, or cystic.

Severe chronic anterior urethritis, a hard infiltration in which the inflammatory exudate has been largely converted into scar tissue, shows a gray, eroded, lusterless surface with no striæ, few or no folds. The gland ducts may project as minute vivid red points in the midst of a mass of congestion

(glandular type) or these red spots may be absent (dry type). Sclerotic white patches or stellate white scars may appear here and there. Rarely one may see a patch of leukoplakia, pink or chalky white, rough upon the surface, a distinctly thickened spot from which the edge of the tube retreats with a jump.

When anterior and posterior urethroscopy are done simultaneously, as is often convenient, the anterior urethra is viewed in distention through the straight closed tube. Its walls do not fall together. One sees infiltrations much more plainly than with the open tube, as pale or granulating, rigid areas encroaching upon the lumen of the canal. They may be cracked and bleeding. They must be distinguished from the normal irregularities of the canal which appear as crescentic folds, especially on the roof and chiefly in the scrotal portion of the urethra. The normal mucosa does not show the red striæ described above, but is all of one pale pink color. In the floor of the bulb, a fold of mucosa overlying the orifices of Cowper's ducts may be seen. Granulomata appear more plainly in the distended than in the collapsed urethra.

Urethrocystoscopy.—The direct-vision water-filled scope, which is sold in this country under such names as the Geiringer, Stern or Buerger urethroscope or as the Braasch cystoscope, has almost as wide a range of observation within the bladder as the Nitze or prismatic cystoscope and adds to its intravesical field the possibility of examining the whole urethra as the instrument is being extracted. Most urologists prefer the prismatic cystoscope for routine work, though at the Mayo Clinic the Braasch instrument is used for this.

The McCarthy panendoscope has an angle of vision at 45 degrees, with the two advantages of being useful for operative work with straight instruments and permitting the introduction of larger instruments than any other scope used in America. As an observation instrument it seems inferior to either of the older types.

Such instruments are usually thought of as urethroscopes especially devised to examine or treat the posterior urethra. Actually their utility as diagnostic instruments within the bladder is quite as great as it is within the urethra.

Caudal anesthesia is essential for posterior urethroscopic diagnosis or treatment. Without it the operation is cruel. I have employed caudal anesthesia as an office procedure for the last two years.

The technic of urethrocystoscopy begins with the difficult introduction of this straight tube. It must be introduced into the posterior urethra far more gently and more slowly than any other instrument. It is very likely to tear the membranous urethra, and its outer extremity must be depressed well beyond the line of the patient's body in order to make its beak ride into the bladder.

During this introduction of the instrument, the following observations are made: (1) Presence or absence of stricture of the urethra; (2) angle at which

the outer end of the instrument must be depressed in order to get it into the bladder. If the bladder neck is paralyzed, the instrument slips in without perceiving any obstruction at all and lies with its outer extremity above the coronal plain of the body. If there is prostatic sclerosis or enlargement, the outer end of the instrument must be deeply depressed to get it in, after which it lies with its outer end below the coronal plain.

The obturator is removed and the telescope introduced. The water is turned on and one observes that part of the fundus against which the end of the instrument is resting. The ocular end is then elevated so that the angle between the floor and the fundus is brought into view and the scope withdrawn while the operator observes the presence or absence of inflammation, diverticulum, tumor and stone. The ureteral mouths are inspected and seem much more magnified than when seen with the prismatic cystoscope. Any inflammation of the trigone will appear in profile as a rough surface upon which small ulcers or cysts may be seen. Cystitis cystica is quite commonly noted about the bladder neck by this instrument when it passes unperceived by the prismatic cystoscope.

The urethroscope is now withdrawn through the bladder neck in which are noted the relaxation of paralysis or the rigidity of sclerosis, while one observes the granular irregular edematous looking folds characteristic of infection, the waving fronds of granulations, the intrusion of enlarged lateral lobes of the prostate, the bullous edema or infiltration of carcinoma.

On retreating into the posterior urethra, one looks sharply for minute surface changes and, if any such catch the eye, one interrupts the constant inflow of water as repeatedly as necessary to bring the suspected lesion into various degrees of focus or to make granulations flop to and fro, thus identifying them more precisely.

The floor of the urethra is readily inspected. One must not fail to glance at the posterior wall of the verumontanum, as it begins to appear; and at the lateral walls of the urethra with their overhanging masses of lateral prostatic lobes; and at the roof, to see which the ocular end of the tube must be pulled firmly downward; and at the lateral sulci at the base of the verumontanum.

One notes the tone of the bladder neck at different water pressures (flaccidity is a sign of paralysis), the increased length of the descent from bladder neck to the verumontanum (significant of prostatic sclerosis or enlargement), the irregular scars in this region left by operation or abscess, the enlargement of the verumontanum from sexual un-hygiene or inflammation, its atrophy from severe inflammation and also the following pathological conditions:

Chronic urethritis when generalized and active gives the mucosa a red, rough, swollen appearance. As it subsides it may leave a sclerotic bladder neck, the mucosa over this inflamed and dotted with Pelouse bodies, or it may leave granulomata in various portions of the posterior urethra.

The Pelouse bodies [1] begin as minute granules similar to those seen on the trigone. They often develop into thin-walled cysts. They cluster about the bladder neck.

Granulomata may develop of such size as to fill the lumen of the urethroscopic tube. They occur everywhere in the prostatic urethra. They are indistinguishable except by biopsy from true papillomata, which occur in the urethra secondary to papilloma or carcinoma of the bladder.

Polyps are distinguished by their smooth surface and long pedicle. They do not bleed from contact with the urethroscope as do granulomata. They are very rare.

The membranous urethra shows nothing to the urethroscope beyond the redness of urethritis, inflamed orifices of glands or the eroded rigid surface of an infiltrate or stricture.

URETHROSCOPIC TREATMENT

Anterior Urethra.—Urethroscopic treatment of the anterior urethra is calculated to benefit only those cases that show distinctly localized granulomata or suppuration. The unskilled urethroscopist, who always sees a few reddened or infiltrated spots along the urethra and wastes his time in cauterizing or incising these, accomplishes nothing, for *in most cases the underlying lesion is a widespread sclerosis, to be influenced only by general dilatation.* Yet there are exceptional cases: ulcers and granulomata to be cured by cauterization with 20 per cent silver nitrate solution, or by the high frequency current; single suppurating glands to be drained by incision and healed by applications of silver nitrate solution once a week or so; long para-urethral ducts exuding pus and requiring that they be slit to the bottom and then cauterized. In general, however, the neophyte will not profit by attempting this form of local treatment.

Posterior Urethra.—The lesions that are treated by urethroscope are granulations, papillomata, polyps, cysts and Pelouse bodies, verumontanitis, inflamed glands, sinusitis, vesiculitis, sclerosis of the bladder neck.

Granulomata are destroyed by cauterization. The 10 per cent silver nitrate solution usually employed is efficient but slow. This requires too many treatments. Fulguration is very efficient, employed as for bladder tumors. With sacral anesthesia it is not too painful, though the posterior urethra is much more sensitive than the bladder and nervous patients protest against the duration of each treatment. I habitually use the direct vision scope for observations and replace this by a panendoscope for treatment.

The result is considerable pain, frequent urination, with pus and blood for a day or two. The operation should not be repeated within two weeks. Two cauterizations suffice to destroy any one granuloma.

True papillomata, polypi and *cysts* are destroyed in the same way.

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[1] *J. Urol.*, Mar., 1922, vii, 165.

Verumontanitis is treated by cauterization through a straight tube with 20 per cent silver nitrate solution.

Littritis is treated by dilatation.

Sinusitis is treated by irrigation of the sinus pocularis with 1 c.c. of 1 per cent silver nitrate introduced through a ureter catheter.

Vesiculitis has been attacked by catheterization of the ejaculatory ducts by Luys and Young. Such treatment has not been proven to have any clinical value and may excite epididymitis.

URETHROSCOPY IN THE FEMALE

To one familiar with urethroscopy of the male urethra, urethroscopy in the female requires no interpretation. Inflammation, granulation, papilloma, caruncle, stricture, rigid bladder neck, Skene's glands (which suggest Littré's); the variations of any of these from the male prototype is not noteworthy.

CHAPTER VI

CYSTOSCOPY

Cystoscopy is inspection of the interior of the bladder. The instrument employed, the cystoscope, consists essentially of a tube or telescope, through which the operator looks, and a source of illumination. Modern cystoscopes are of two types, viz.:

1. The closed tube cystoscope, employed with water or water in the bladder (Leiter, Nitze, Albarran, Brunner, Boisseau du Rocher, etc.).

2. The open tube cystoscope, employed with air in the bladder (Kelly, Luys).

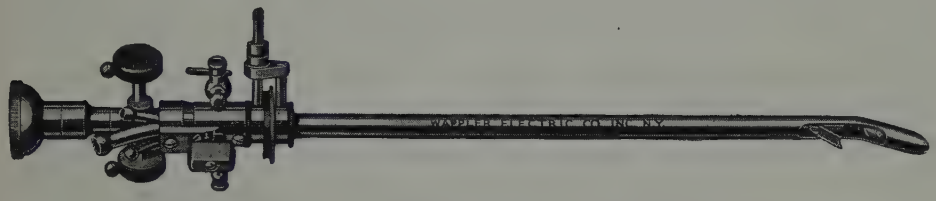


Fig. 22.—Universal Wappler Cystoscope

The Closed Tube.—This instrument, originally devised by Leiter and Nitze, modified and improved by many urologists and instrument makers, is almost universally employed at the present time. It is fully described below.

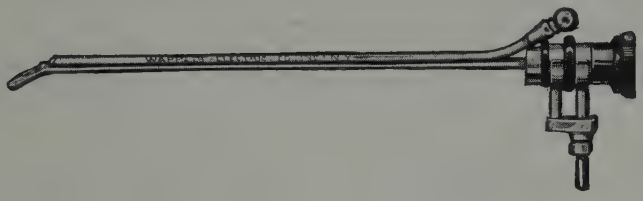


Fig. 23.—Beer's Infant Cystoscope

The single catheterizing attachment is detachable. The Butterfield cystoscope has the catheterizing attachment on the concavity which makes it somewhat more easy to introduce.

The Open Tube.—For use in women Howard Kelly devised a straight open tube cystoscope, to be introduced with the patient in the knee-chest position and illumined by light reflected from a head mirror.

Luys has adapted this instrument for use in the male, by introducing it on a flexible obturator, and adding a suction tube to keep the bladder dry, so that the knee-chest position is not required.

The direct vision posterior urethroscope is used for the treatment of certain bladder lesions. But the restricted range of vision disqualifies all direct vision instruments for general diagnosis of bladder lesions.

THE CYSTOSCOPE

The cystoscope consists of two parts, the sheath and the telescope. Most European cystoscopes unite the two indissolubly. In the United States, thanks to the late F. Tilden Brown, all cystoscopes are constructed with removable telescopes. These instruments have the following virtues:

1. They render cystoscopy feasible in any bladder however contracted, however sensitive, however filled with pus, tumor, stones or blood-clots.

2. They permit a study of bladder physiology as well as of bladder anatomy, for the organ is viewed in the process of filling and emptying.

3. Through the same sheath various telescopes may be introduced, thus permitting a variety of observations or treatments without the delay and inconvenience of reintroducing the whole instrument.

The lenses of the telescope may be arranged in four ways, viz.:

1. The prismatic, or indirect-vision telescope looks out at right angles to the shaft of the sheath. The window through which it looks may be on the concavity (Nitze type) or the convexity of the sheath. The Nitze type enjoys a more general popularity. The prism naturally inverts the image, but a system of lenses has been devised to correct this inversion.

2. The direct-vision telescope looks directly out through the end of the sheath. It has the restricted field of vision of an open tube. This type of telescope, though never generally employed abroad, still enjoys considerable popularity in this country.

3. The retrograde telescope looks back toward the observer, giving a view of the bladder neck and adjacent bladder wall. Young's cystoscope includes a retrograde attachment.

4. McCarthy's panendoscope deflects the line of vision but 45 degrees. With it one sees operating instruments that are introduced without angulation.

The cystoscope is spoken of as catheterizing, operating, or examining, to accord with the presence or absence of tunnels, attached to the telescope for the admission of ureter catheters or other instruments.

The Choice of an Instrument.—The following considerations may help in the choice of an instrument:

1. Its maker should be accessible. The importation of cystoscopes from distant countries involves harassing delay, expense and misunderstanding, when repairs are required.

2. The instrument should be simple, its lamp "cold," its lenses corrected for inversion of image, its caliber not more than 24 F.

Most European cystoscopes admit two 8 F. catheters. The popular models in this country take two No. 7.

Small instruments are made for use in children. Under general anesthesia and with the help of meatotomy a cystoscope of 18 F. caliber can be introduced into the urethra of a one-year-old girl or a four-year-old boy. The smaller instruments of Beer and others are needed for infants.

Beyond this it is impossible to specify. Each year brings forth some new improvement or some change in fashion.

Operating Cystoscopes.—Cup-bladed biopsy forceps for obtaining specimens of tumor or ulcer, insulated fulgurating wires and a special fulgurating tip for enlarging the ureteral orifice, form part of the standard cystoscopic equipment. Young and Lowsley have devised rongeur cystoscopes to obtain large specimens and to catch foreign bodies.

PREPARATION FOR CYSTOSCOPY

Instruments Required

Ureter Catheters.—The best sizes are 5, 6 and 7 F. The catheter should have at least two eyes. The Albarran flute-tip catheter (Plate II, Fig. 1) catches the urine better than any other, but it is well to have a few olivary-tip catheters for entering rebellious ureters. In order to estimate how far the catheter enters the ureter, instruments are marked off with gold stripes at each distance of 5 cm. In as much as the ureter mouth is approximately 25 cm. from the renal pelvis in one direction and the ocular end of the cystoscope in the other, the 5 cm. markings run to 25 cm. and then repeat, so that the distance traveled by the catheter up the ureter may be read either inside or outside. The various types of ureter catheter are illustrated on Plate II.

Each urologist must make his own choice among the ureteral dilating catheters and stone-extracting instruments.

Cystoscopic Accessories.—Always have everything in duplicate: cystoscope, lamps, connecting cords, etc.

Source of Light.—Three ordinary dry cells in a box with rheostat attachment form a safer source of light than the house current. If the latter is used one must never forget the danger of "grounding" by wet floors and pipes.

Source of Irrigation.—At home one uses a wall tank full of unheated solulution of cyanate of mercury, 1:10,000. This mild antiseptic minimizes post-cystoscopic infection. Elsewhere one uses a bulb syringe.

Anesthesia.—Cystoscopy as usually performed is a scandalously painful operation. It is true that a woman may be cystoscoped painlessly with a small instrument, sometimes with no anesthesia at all, sometimes with 10 per cent novocain local anesthesia. Moreover, general narcosis by morphin or twilight sleep is sometimes employed with advantage, but the ideal anesthetic for cystoscopy is the caudal injection of 30 c.c. of 2 per cent novocain, supported by a total urethral injection of 10 per cent novocain retained by means of a

clamp (Plate II, Fig. 16) in the anterior urethra for fifteen or twenty minutes. This anesthesia, which covers the whole base of the bladder, renders the passage of ureter catheters painless and apparently minimizes the tendency to post-cystoscopic ureter colic. With it the ordinary cystoscopic intravesical operations upon tumors, etc., are rendered painless. Caudal anesthesia has no inconveniences as an office procedure for the patient but it requires of the urologist a rigid surgical asepsis.

These statements are based upon an office practice of constantly repeated caudal anesthesias during the past two years.

The beginner will do well to form the habit of performing all urethroscopies and cystoscopies under caudal anesthesia and then permit himself such license as his patients will tolerate.

Cocain should never be used in the urethra. Braasch uses it but many cases of grave syncope have been reported following its use.

Urethral Instruments.—One may require a blunt-end bistoury to cut the meatus, bougies or sounds to dilate a stricture, "natural curve" woven catheters, 10 F., to place in the bladder with the ureter catheter, and 16 F. to empty the bladder after the cystoscopy.

Other Accessories.—"Visible" ureter catheters for radiography, solutions and syringes for the injection of phenolsulphonephthalein, morphin, etc., sterile test-tubes, appropriately labeled, for the collection of specimens of urine, basins, rubber apron, urine glasses, etc., should be provided, according to the requirements of the individual.

The modern cystoscopic table is provided with a Buckie diaphragm and a radiographic outfit. The Squier table is, at the moment, the most popular.

Sterilization

Instruments.—Most of the instruments and accessories used in cystoscopy may be sterilized by boiling or in the autoclave. Barney has even made the very ingenious suggestion that the ureter catheters be boiled in lengths of rubber tubing and be attached to the cystoscope encased in these, and so fed into the cystoscope, protected from contact even with the operator's hand, not to mention his head.

But the cystoscope itself may not be boiled. It must be sterilized, after due cleansing with soap and then alcohol, in a solution of carbolic acid, alcohol or cyanate of mercury or in formalin vapor.

Such being the case, and in as much as the patient's urethra cannot be rendered fully aseptic, one must deal in antiseptics. Accordingly cystoscopes with their accessory cords, rheostats, etc., are kept sterile in a cabinet in which a formalin lamp is lighted for at least an hour before each cystoscopy.

Ureter catheters are cleansed inside and out in running water immediately after use. They should lie several hours in 1 : 5,000 cyanate solution. Then

they are kept in the formalin cabinet with the cystoscopes. This may seem an excessive sterilization; and, indeed, it interferes with cultivation of bacteria, unless the urine is directly implanted from the catheter into the culture-medium.[1] But contemplate the dangers of tuberculosis inoculation from unclean catheters!

The Patient and the Operator.—The penis or vulva should be cleansed and surrounded by a perforated sterile sheet, as though for a surgical operation.

The operator should be clean as for a surgical operation.

Preparation of the Patient

A preliminary course of bladder irrigation, urotropin medication, or toughening the urethra by the passage of sounds, is appropriate in some instances.

The operation may usually be performed in the physician's office or at the clinic. But enfeebled or nervous patients, especially nervous women, will appreciate being examined at home or in a hospital.

Since the bladder may not empty itself spontaneously through the sheath of the cystoscope if the patient lies flat, the head of the table should be raised. The buttocks are brought to the end of the table, the feet or knees supported on rests.

The nervous woman much prefers being cystoscoped in the Sims' position. If the bladder is fairly normal this does not entail very grave inconvenience to the operator.

CYSTOSCOPY

When all is ready, the operator glances through the telescope to be sure the lenses are not fogged, then attaches the sheath of the cystoscope to the source of electricity to test the lamp. The rheostat is set at the correct point, the wires again disconnected.

The cystoscopic sheath with its obturator in place is lubricated and introduced.

The female urethra presents no obstruction other than a little tightness sometimes encountered.

The cystoscope is introduced into the male urethra like a sound. Its entry into the posterior urethra is facilitated by firm downward pressure over the pubes to relax the suspensory ligament. It may slip quite readily over the bladder neck or it may have to be still further depressed, aided by the pubic counterpressure until the long axis of the shaft swings beyond that of the patient's body. The tip may even have to be lifted by a finger introduced into the rectum. But one must always remember that, as in the case of the sound, entrance into the bladder is effected by swinging the shaft into correct position, *not by pushing.*

Any doubt as to whether the instrument has actually entered the bladder

[1] But it does not interfere with guinea-pig inoculations for the diagnosis of tuberculosis.

is settled by removing the obturator, and injecting a little water. This returns freely if the cystoscope is properly placed, with its aperture turned toward the vault of the bladder.

Enough water is then injected to clear the bladder of blood, pus and lubricant. This is most quickly accomplished by injecting about 20 c.c. at a time. When using a modern irrigating instrument one need not irrigate the bladder beforehand, or take any special precaution to have the fluid absolutely clean before introducing the telescope. For repeated in-and-out irrigation during the operation is the best method of cleaning the field of much pus or blood.

The telescope is then introduced, a stopcock opened to admit the irrigating fluid, and the examination begun as the bladder is filling with water. The patient's complaint, if the bladder is much inflamed, or the obliteration of folds, if it is not, is the signal for shutting off the inflow of water.

In order to estimate the capacity of the bladder, to note the movement of the bladder wall, to catch sight of small tumors, etc., the cystoscopy should always be begun as the bladder begins to fill and concluded as it empties.

The order in which the various parts of the bladder are examined will depend upon the habit of the operator, and will vary somewhat with the emergency of the case. But it is well to follow a definite system lest one overlook some unsuspected lesion. The practice of plunging the cystoscope into the bladder and two catheters into ureters, and then retreating without so much as a glance about the rest of the organ cannot be too strongly condemned.

We employ the following order in examining the bladder: the bladder neck, the trigone, the ureter orifices, the fundus, especially that part adjacent to the ureters, and finally the vault. With certain cystoscopes one may also examine the posterior urethra as one withdraws the instrument from the bladder.

If indicated, the ureters are then catheterized, or any operative work performed. At the close of the cystoscopy the bladder is emptied, through the sheath, after withdrawal of the telescope. Then there should be injected about 20 c.c. of some unirritating antiseptic solution. I prefer acriflavin, 1 : 1,000 solution.

Treatment after Cystoscopy.—To most patients a cystoscopy means no more than a considerable discomfort for a few minutes, followed by a soreness at the neck of the bladder lasting a day or so. But the operation may be followed by a chill, cystitis, pyelonephritis or renal colic. The infectious complications only occur in cases already infected and draining badly. Hence they may be foreseen and properly guarded against by antisepsis, gentleness, and keeping the patient quiet. Inflammatory complications following the operation are to be treated in accordance with the usual rules.

Renal colic following ureter catheterism may not be foreseen. Trauma causes and gentleness avoids it. Yet it seems much rarer in those who are able to rest after the operation than in those who have to go about. Conse-

quently it is wise to set the cystoscopy for a time when the patient shall have nothing to do for the rest of the day.

Appearance of the Normal Bladder

The Normal Bladder Neck.—As soon as the bladder begins to fill with fluid one may examine the bladder neck. With the prism directed upward, the cystoscope is gently withdrawn until there suddenly appears in the field, close to the instrument, a dark red body. This is the bladder neck. If normal it is a crescent with the concavity away from the cystoscope. This fold may be smooth and regular, or it may be lumpy and edematous looking. Though the latter picture suggests inflammation it may well be entirely within the normal, and one should not infer that the bladder neck is inflamed unless the cystoscope shows evidence of inflammation elsewhere.

Keeping this crescent in the field, the cystoscope is now revolved in the direction of the hands of a watch. The normal bladder neck retains its concave, sharply outlined appearance until the cystoscope has made about one-third of a revolution. At "four o'clock," however, the sharply outlined ring flows insensibly into the trigone. The ring is lost in this until the cystoscope has completed another third of its circle. Then at "eight o'clock" it is picked up again and carried around to the starting point. At the junction of bladder neck and trigone one can follow the lateral edge of the trigone as a rather well-defined ridge, by pushing the instrument inward.

The Normal Trigone.—Having completed the inspection of the bladder neck, the cystoscope is once again revolved a half turn to "six o'clock." With the prism looking downward it is now pushed into the bladder about one centimeter and as it goes one observes the surface of the trigone—a surface covered with a sheaf of vessels spread fanwise from the bladder neck toward the posterior edge of the trigone, the interureteric bar. That these vessels are not plainly visible may simply mean that the prism is too close to the trigone. Depress the instrument a trifle and they spring into view. After the cystoscope has thus been pushed in about one centimeter from the bladder neck the edge of the trigone, the interureteric bar, springs into view. Up to this point the mucosa of the trigone has been smooth, a rather dark red, streaked with its radiating vessels. Beyond this transverse bar is seen the fundus, rather wrinkled than smooth, distinctly paler than the trigone, and etched with smaller vessels running hither and thither quite irregularly.

The prominence of the interureteric bar varies greatly in different individuals, and with different degrees of bladder distention. If the bladder is only partly filled, and the patient a man, the bar usually stands out quite distinctly with a definite pocket immediately behind. But if the bladder is distended, and the patient a woman, especially a multiparous woman, the trigonal markings may be quite obliterated; so that one cannot tell precisely where the trigone ends and the fundus begins. Here again the novice is likely

to make the mistake of keeping the cystoscopic prism too close to the bladder wall. If he becomes confused let his first thought be to depress the ocular end of the prism in order to get a more distinct view of the interureteric fold. Indeed, if the lens is kept a little way from the trigone the whole of it will be inspected by the motion of pushing the cystoscope in until the interureteric fold comes into view, and then turning it to find the ureters.

The color of the ureter mouth depends largely upon the illumination and distention of the bladder. One may lay down the rule that neither ureter orifice nor bladder neck should be considered inflamed unless there is evidence of inflammation on the adjacent bladder wall.

In shape the normal ureter orifice may appear a wee round hole, a slit, or a "U" fold of mucosa. Contraction of the ureter shows itself by a slight motion in the mucosa followed by a sudden opening of the little hole or slit from which comes a swirl of urine. No very profound conclusions can be drawn from watching the contractions of the ureter. It may be important to note that a bloody or purulent flood issues from it, and one may note that it does contract. But that it does not contract proves nothing. This may be due to reflex inhibition of peristalsis.

In as much as the ureter mouth lies at the junction of the base and lateral edge of the trigone, it may be found by following either of these lines. The simplest way to find the ureter mouth is depicted in Plate III. The cystoscope is pushed in until the bubble of air is seen at the top of the bladder. It is then rotated 180 degrees, and the interureteric ridge identified. The trigone is redder than the fundus beyond it and the vessels upon it, less distinctly visible than in the fundus, are close together and radiate fanwise from the urethral orifice.

After the ridge has been found the cystoscope is rotated about 40 degrees, following the ridge until the angle of the trigone is seen, with its sheaf of vessels extending at an angle of about 40 degrees upward and laterally. Upon this trigonal angle the ureter mouth appears.

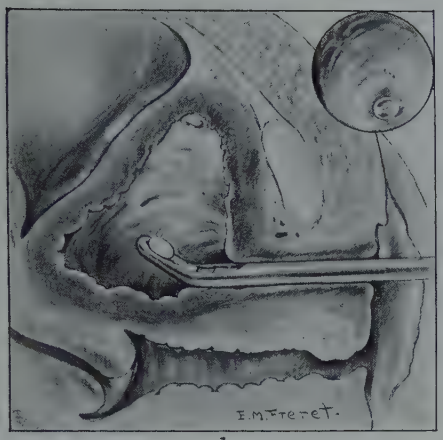
The beak of the cystoscope is now turned laterally until it is over the ureter mouth, and simultaneously rotated to "six o'clock" again to keep this in view.

The method just described is the most generally satisfactory; but in some instances obliteration of the trigonal markings may make the lateral edge of the trigone a better guide. This extends from the bladder neck (at about "four" or "eight o'clock") almost directly inward to the angle of the trigone, and usually can be quite readily followed, if the prism of the cystoscope is depressed fairly close to the trigone, and rotated toward the side so as to throw the lateral edge into sharp relief against the bladder wall behind it.

The Normal Fundus.—The fundus is that part of the bladder lying immediately about and beyond the trigone. Its surface is somewhat irregular, even when the bladder is full, and when the organ is not fully distended the fundus may be wrinkled in transverse folds of considerable depth. For a proper examination of this surface it should be fairly well upon the stretch. Then it appears as a relatively pale mucous membrane, covered with interlacing

PLATE III.—URETER CATHETERISM.

1, The cystoscope held in the sagittal plain of the patient's bladder. Air bubble is seen; 2, The cystoscope is rotated 180°. The intra-ureteric ridge is seen; 3, As the cystoscope is further rotated the eye follows the ridge until the ureter mouth is seen; 4, The shaft of the instrument is deviated and simultaneously rotated to bring the lens over the ureter mouth; 5, The ureter catheter is pushed into view (*a*), and on until its tip is just beyond the field of vision (*b*), when it is brought back into the field of vision (*c*) by tilting the lever; 6, The catheter is introduced into the ureter by manipulating the cystoscope and catheter as one solid body.



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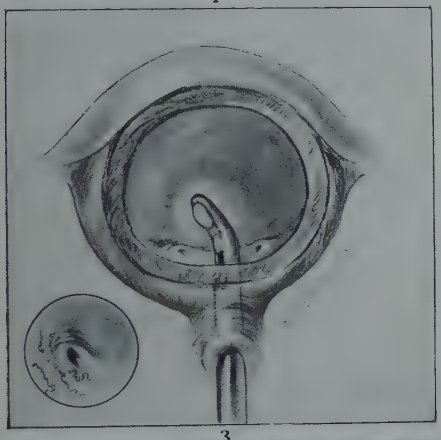

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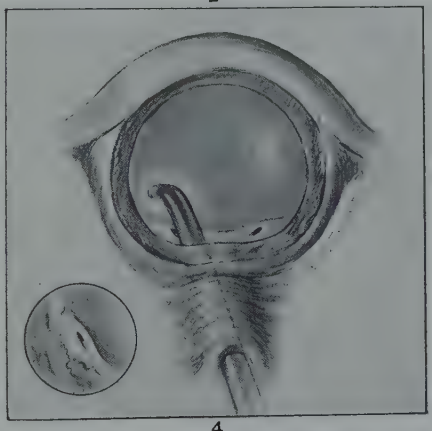

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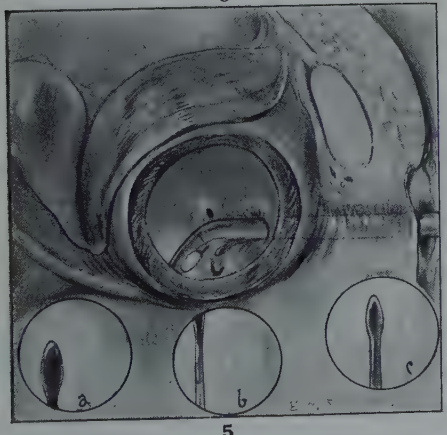

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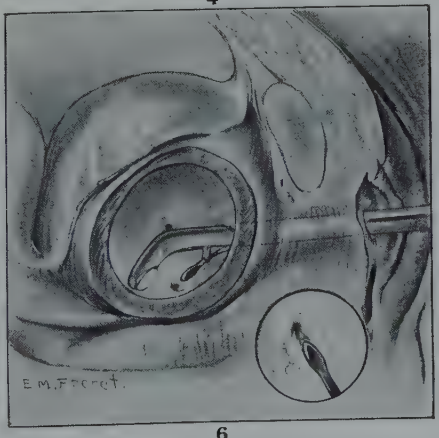

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small red blood-vessels. The region about the angles of the trigone should be most carefully examined as this is the point of origin of most primary papillary tumors and saccules; while here also may be seen the most intense evidence of tuberculous and other inflammations.

To examine the fundus fully the ocular end of the cystoscope should be depressed, and the instrument pushed until it will go no further, or until the light becomes obscured by a fold of bladder wall. The instrument is then withdrawn again toward the trigone and, both going and coming, it is rotated gently from side to side, so that the eye sweeps across the whole base of the bladder.

The Vault.—The cystoscope is then turned over until its prism points directly upward. In the rather dim distance one sees the pearly bubble of air that floats at the top of the water in the bladder, and forms the center from which our observations radiate. From this center one withdraws the instrument, moving it a little from side to side, and inspecting the bladder wall until the bladder neck comes into view; then back to the bubble, and a lateral wall is inspected, as the instrument is slowly swept downward until the trigone comes into view. The opposite wall is then covered in the same way, and finally the ocular end of the instrument is elevated and the instrument pushed inward until one has seen all that remains of the bladder wall beyond the bubble.

In order to see the whole bladder, this examination must be repeated with various degrees of distention.

The prismatic cystoscope has a "blind-spot," corresponding with the center of the subperitoneal area. To see this well one must employ a direct-vision instrument. But this blind-spot is very small if, during the course of the examination, the area is inspected first from one side and then from the other, with the beak of the cystoscope as far laterally as possible.

CHAPTER VII

CYSTOSCOPY OF THE DISEASED BLADDER

Cystoscopy is required for the precise diagnosis of every disease of the bladder and ureters, and every surgical disease of the kidneys. To enumerate these would be to waste space. Even the expert may profitably hold strictly to the letter of this rule. The very case in which it seems most reasonable to omit cystoscopy may conceal some important and unsuspected element that could have been revealed only by this method of examination.

The most absolute contra-indication to cystoscopy is ignorance or incompetence on the part of the operator. Interpretations of pathological conditions must be founded upon a long and careful study of normal conditions. In the patient, himself, urethral obstruction by stricture, prostate or calculus may prohibit cystoscopy. Gonorrhea is a contra-indication unless the need of information is imperative and the importance of the information to be gained outweighs the danger from urethral trauma. Other contra-indications, such as the irritable bladder itself or the patient's debility, may usually be met by careful preparation and intelligent selection of anesthesia.

THE INFLAMED BLADDER

That the bladder is not inflamed is judged from the appearance in its mucous membrane of fine branching blood-vessels. When these blood-vessels cannot be seen, through a clear medium, the bladder is inflamed. The neophyte will mistake variations in color of the mucous membrane for inflammation, though such variations may be due to differences in bladder distention and degree of illumination. This tendency to see inflammation where it does not exist he will evince especially in relation to the urethral and ureteral orifices. Mild, general cystitis shows itself only by the disappearance of branching vessels that should be seen in fundus and vault. The trigone is almost invariably the seat of the most marked inflammation. Here it is difficult to distinguish slight inflammation since this may not absolutely obscure the vessels. A more intense inflammation shows itself characteristically by throwing the naturally smooth surface of the mucosa into little irregularities resembling a granulating surface. But the suggestion of inflammation upon the trigone should always be certified by examination with a direct-vision instrument which magnifies the inflammatory irregularity of surface of the trigone by showing this in profile. Observation of this will prevent many mistaken diagnoses of inflammation about the bladder neck, or about the ureter mouth.

The appearance of irregularly distributed areas of redness and obliteration of the bladder vessels is often spoken of as characteristic of tuberculosis. Yet this condition is seen in many non-tuberculous conditions; especially with bladder sacculation, ureteral stone, pyelonephritis and ulceration of the bladder.

Bladder ulcers, occurring in the course of acute cystitis, appear as small whitish erosions, quite comparable to aphthous spots in the mouth. The ulcers of chronic cystitis rather resemble thickened red granulating areas set in an areole of inflamed mucosa. They may show markedly exuberant granulations and be covered by patches of slough or incrusted with phosphates. Such ulcers are readily mistaken for infiltrating carcinoma. On the other hand, ulcers of the so-called "Hunner" or "elusive" type are red spots so small as to be readily overlooked altogether. They are readily diagnosed, however, by the fact that they crack and bleed freely when the bladder is overdistended and are exquisitely sensitive to touch by the ureter catheter.

Leukoplakia I have seen but twice. It showed a pearly whiteness in the midst of a red areola of cystitis.

TUBERCULOUS CYSTITIS

The changes described above, with the exception of leukoplakia, may, any or all of them, be seen in the tuberculous bladder. The more intense, ulcerative and localized the inflammation, and the more it centers about one or the other of the ureter orifices, the more likely is it to be tuberculous. It is perilous to describe any type of cystitis as peculiar to tuberculosis. Even the little tubercules in the mucosa may be simulated in cystitis cystica. Biopsy is the final diagnostic test of this condition.

THE INFLAMED URETER MOUTH

The acutely inflamed ureter mouth shows a distinct edematous swelling of its lips. The redness spreads over and obliterates the vessels on the adjacent portion of the fundus. As a result of the pouting of the ureteral orifice it looks as though the opening were enlarged, though doubtless the swelling actually diminishes the lumen of the canal.

Chronic inflammation of the ureter mouth (Plate I) includes five changes, viz.: surface inflammatory changes, change in shape, change in function, retraction, and change in the ejected stream.

Surface Inflammatory Changes.—These are similar to the changes of chronic cystitis already described. The ureter orifice may be lost in the inflamed mucosa or it may appear as an intensely inflamed or ulcerated region in the midst of which the ureter mouth is very hard to find unless dilated.

Change in Shape.—Inflammatory infiltration and cicatricial contraction about the chronically inflamed ureter mouth may cause various changes in its shape. As a rule the orifice appears dilated while the inflammation is still

active. This dilatation may make it appear as a long slit, or as a relatively open round hole. The earlier cystoscopists used to describe a "golf-hole" ureter, a rigid, round, wide orifice. Such an orifice is typical of prolonged chronic ureteritis. But it is not often seen, nor is its absence any evidence of the fact that the ureter is not chronically inflamed. The "golf-hole" is changed to a "tunnel entrance" by retraction of the ureter mouth, as described below.

Change in Function.—Just as the ureter may be chronically and severely inflamed without any notable change in the shape of its orifice, so its function is not disordered by chronic inflammation unless that inflammation has invaded the muscular coat and impaired its peristaltic action. If this has occurred the ureter remains still and open, while the purulent or bloody urine dribbles from it in a more or less constant stream.

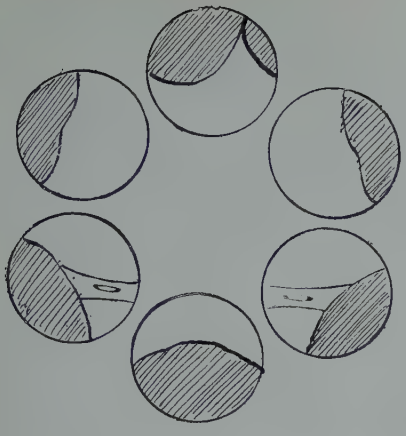
Retraction.—Retraction, like interference with function, means infiltration of all the coats of the ureter of sufficient intensity and duration to impair the elasticity of the duct and so to pull the ureter mouth upward and outward. Such retraction is often associated with considerable inflammation and ulceration about the ureter mouth. But if this has in large measure subsided, the ureter mouth may be left open, "golf-hole," and this "golf-holed" orifice retracted toward the side of the bladder appears like the entrance to a tunnel, with the pale, scarred, tense trigone appearing as the floor of the tunnel.

Change in the Ejected Stream.—In as much as the inflammation about the ureter mouth usually implies infection of the kidney pelvis, one may look for pus in the urine ejected. But even though the kidney be gravely diseased, the amount of pus in the ejected ureteral stream may be so little as to be distinguishable only under the best of circumstances as to light, freedom from pain and freedom from pus within the bladder. Therefore, while meatoscopy, as it is called, *i.e.*, inspection of the ureter mouth, may reveal pus issuing from the ureter, this information is obtained more accurately by ureter catheterism. Any considerable delay for inspection of the stream as it issues from the ureter is worth while only when some previous effort has shown that it is impossible to introduce the ureter catheter.

PROSTATIC ENLARGEMENT

Enlargement of the prostate may be due to various causes, notably to senile hyperplasia, abscess, cyst or carcinoma. Whatever its cause, the enlarged prostate occasions a threefold bladder deformity, viz., of the bladder neck, of the trigone, of the remainder of the bladder.

Moreover, the introduction of the cystoscope is somewhat impeded by the enlargement. If, as is usually the case, the posterior commissure is thickened, the cystoscope meets an obstruction as it reaches the bladder neck, and its ocular end must be depressed in order to permit the beak to surmount this obstruction. Also the instrument must be pushed in further than usual to reach the bladder cavity (this increase in the length of the urethra being a rough measure of the



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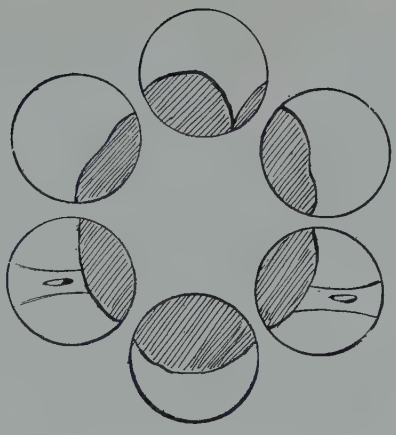

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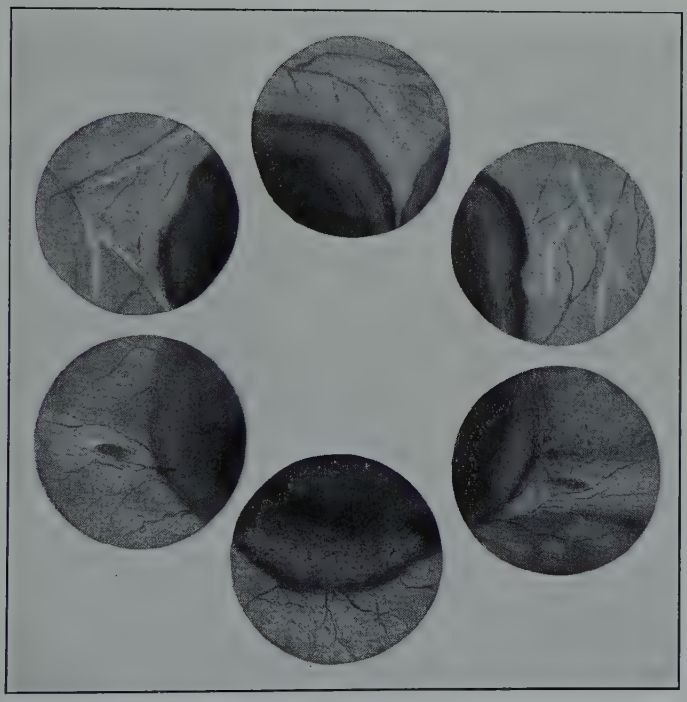

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PLATE IV.—CYSTOSCOPIC INTERPRETATION OF THE APPEARANCE OF THE BLADDER NECK IN PROSTATISM.

The enlargement illustrated is exceedingly slight for it permits the ureter orifices to be seen but its shape is the usual one characteristic of general enlargement.

Fig. 1.—As the cystoscope is rotated it sees each segment of the bladder neck as a project convexity in place of the normal concavity, excepting at the apex where the size of the enlargement is estimated by the depth of the crease between the two lateral lobes.

Fig. 2.—The picture interpreted.

Fig. 3.—The actual condition as seen.

increase in the length of the prostate), and it will be noted that as it rests in the bladder the shaft of the instrument does not lie in the plane of the patient's trunk. Its beak is lifted up and points toward the anterior abdominal wall, its ocular extremity being correspondingly depressed. These three items, (1) the obstacle at the bladder neck, (2) the lengthening of the urethra, and (3) the deflection of the shaft, are to be noted in every cystoscopy. If the enlargement involves only one side of the prostatic orifice, the cystoscope will be deflected correspondingly.

The direct vision cystoscope helps diagnose obscure enlargements by visualizing enlargements within the urethra, the lengthening of the canal and the deformity at the bladder neck.

The retrograde cystoscope defines tumors about the bladder neck and deformities of the trigone better than it does the actual prostatic enlargement.

Prostatism.—Cystoscopy is useful chiefly to prevent the operator overlooking tumor or diverticulum. Braasch omits it as routine, in favor of cystography.

General enlargement lengthens the urethra and deflects the cystoscope, as stated above. After the instrument has been introduced and the bladder washed clean, the lateral lobes are seen (Plate IV) as a projecting mass with a deep cleft at the top, and usually completely concealing the trigone.

Middle lobe enlargement shows a variety of cystoscopic pictures depending upon the size of the lobe. If small, the lobe is seen entire, a small rounded mass, ulcerated if traumatized by previous catheterization, springing from the floor of the bladder neck and overlying the trigone. But if large, the cystoscope enters the bladder to one side of the middle lobe and underlies it. As the instrument is revolved, it shows one of two pictures.

1. If there is no lateral lobe enlargement, the large middle lobe appears as a lateral bulging, with a deep cleft below as well as above it and the opposite side of the bladder neck a concavity.

2. If the lateral lobes are also large, one sees what at first sight appear to be two lateral lobes but with a crease below as well as above. This is the usual picture.

The prostatic bar, whether due to hyperplasia or sclerosis, is diagnosed more precisely by the urethral deformity visible to the direct vision cystoscope, or by the deflection of the shaft of the instrument, than by the view of the bladder neck through the prismatic instrument. Careful inspection with the latter instrument will usually, though not always, show a slight projection from the floor of the bladder neck.

The trigone is partially concealed (to the prismatic cystoscope) by smaller degrees of prostatism (Plate IV), wholly concealed by larger masses. If the concealed trigone is looked at with a retrograde instrument (supposing the masses not too large) its urethral extremity will be found pulled upward, the plane of its surface approaching the transverse.

The remainder of the bladder will be found trabeculated or sacculated and more or less inflamed.

Cystoscopy is harmful if there is *prostatic abscess.* The picture is that of general prostatic enlargement.

A *cyst of the prostate* looks almost precisely like the enlargement of a single lateral lobe of the prostate. The contents are rarely translucent enough to permit transillumination. An enlargement involving only part of a lateral lobe is either cyst or carcinoma.

Prostatic Carcinoma.—A small carcinoma may, like a bar, produce no change in the cystoscopic picture, while a large carcinoma may so distort the deep urethra as to prevent the introduction of a cystoscope. Sometimes the cystoscope reveals irregular changes in the shape of the bladder neck—usually a series of irregular small nodules. These may be mistaken for inflammation or for an irregular type of prostatism unless they extend into the trigone or vault. Actual infiltration of the mucous membrane, in the form of carcinomatous ulceration of papillary growths, is not so often seen (Plate I, Fig. 6).

The trigone is rarely totally hidden, never tilted, usually lifted up by the underlying growth and often edematous.

TUMOR OF THE BLADDER

Papillary Tumor.—Cystoscopic inspection does not disclose the malignancy as a tuft of villi growing from a tenuous pedicle (Plate I, Fig. 15). The large papillary neoplasm is likely to have a cauliflower-like appearance, the villi being packed so close together as to appear fused in bunches. Such a large neoplasm may more than fill the cystoscopic field, and bleed so freely as to obscure the diagnosis. The villi also choke the sheath of the cystoscope and interfere with irrigation.

The great inconvenience in cystoscopy of a papillary tumor is hemorrhage. The bleeding is excited by the slightest contact with the cystoscope, especially with the sharp edge of the window in the sheath. Hence, one should introduce the instrument with extreme gentleness and while keeping the peak pointed upward, empty the bladder fluid through one of the stopcocks while the obturator is only partially withdrawn. After the bladder has been thus emptied, the obturator is replaced by the telescope and the bladder repeatedly filled and emptied through the stopcocks until the fluid is clear enough for a satisfactory inspection. With each refilling, one part or another of the bladder is inspected until one discovers the location of the tumors. Further washings are then performed with the lens turned away from the tumors.

The Ulcerated Papillary Tumor.—Spontaneous ulceration of a papillary tumor usually means that it is malignant. The ulceration covers more or less of the surface of the growth with a white slough, to which phosphatic grit may adhere.

The Non-papillary Ulcerated Neoplasm.—Carcinomatous ulceration of the bladder wall cannot be readily distinguished by inspection from inflammatory ulceration. The diagnosis may be made by biopsy.

Secondary Carcinoma of the Bladder.—Carcinoma invading the bladder from the prostate, the uterus, or other adjacent organs is discovered by other means than cystoscopy but the cystoscope measures the involvement of the bladder wall. The earliest change, excepting growths coming from the prostate, is fixation of the bladder wall at the point of invasion. The fixation may sometimes, though not always, be recognized when the bladder is fully distended by wrinkling or dimpling of the surface drawn to one side. This fixation in cases of tumors extending from the uterus is likely to show itself in mid-fundus, just back of the ureteral orifices. As the carcinoma extends further into the bladder wall the surface of the mucous membrane is thrown into red, edematous folds. The picture shows a circumscribed region not unlike chronic cystitis in appearance. Ulceration does not occur until infiltration has existed for a considerable length of time. Bullous edema, or vesicles, may appear early (Plate I, Fig. 5).

Non-infiltrating Neoplasms.—Under this term we include the non-malignant myofibroma of the bladder wall itself, and such tumors of the adjacent tissue, whether they are malignant or not, as depress the bladder wall without invading it. Such tumors are recognized, after full distention of the bladder, by the fact that they project more or less markedly into the bladder cavity, and difference in distention does not materially alter the position of the point of projection. The mucosa over such projections may or may not be inflamed (Plate I, Fig. 4).

Cystitis Cystica.—This condition is recognized as a scattered or grouped collection of pearly or pink vesicles distributed over a more or less reddened surface of the bladder. It usually centers about the trigone and to the inexpert suggests tuberculosis.

CHANGES IN THE SHAPE OF THE BLADDER

Apart from the normal variations and inflammatory changes in the shape of the ureteral orifice, and the changes in the shape of the urethral orifice due to prostatism or neoplasm, the following changes are noteworthy:

1. Cystocele
2. Ureterovesical cyst
3. Trabeculation
4. Diverticulation

Cystocele.—The importance of cystocele is measured chiefly by the vaginal protrusion, the amount of residual urine and the secondary cystitis. A cystoscopic measure of its extent is the angle at which the cystoscope must be tilted in order to catheterize the ureter; for in proportion as the anterior vaginal wall gives way, the trigone drops from the long axis of the patient's body to the transverse axis, so that to approach the ureter orifice of the well-filled bladder, the ocular end of the cystoscope must be carried well upward. Even when this

is done the trigonal markings are so much obliterated in these cases that identification of the ureter mouth is often extremely difficult (Plate I, Fig. 1).

It is to be noted that cystocele of very considerable degree may result from prolonged straining such as the patient with tuberculosis of the bladder suffers. Such is the cystocele of the nullipara.

Ureterovesical Cyst.—Small dilatations of the submucous portion of the lower end of the ureter are seen as little pouches that balloon up with each wave of ureter peristalsis. If large they are seen as more or less fully distended cysts (Plate I, Fig. 14). If enormous they may so fill the bladder and distort its landmarks as to be very difficult of diagnosis without cystography.

Trabeculation.—The beginner mistakes the folds in the fundus of the normal bladder for trabeculation; practice in cystoscopy will remedy this error. Slight trabeculation can only be recognized when the bladder is completely filled; it then appears as a crisscrossing of little short elevated ridges in the mucosa (Plate I, Fig. 3). It is usually most marked in the fundus. Marked trabeculation is unmistakable, and is often associated with diverticulation.

Diverticulation.—The orifice of a diverticulum appears as a hole in the bladder wall. The mucous membrane about this may or may not appear inflamed. Its size can be measured roughly by the introduction of a ureter catheter, and more accurately by cystography.

STONE

Bladder stones so often contain no lime salts that they are overlooked by the x-ray. The cystoscopist readily identifies small stones as white, yellowish or brown, rounded, movable bodies. They lie on the fundus behind the trigone and are seen beside or above the cystoscope, rather than below it (Plate I, Fig. 2). Large stones will be struck by the cystoscope as it is introduced and may simply show an irregular sloughy looking surface which is not always readily distinguished from that of a sloughing neoplasm. The hardness and mobility of the stone generally settles the diagnosis. It is to be remembered that neoplasms may be incrusted with phosphates and thus give a gritty contact. Stone in a diverticulum is almost always phosphatic, and therefore discoverable by the x-ray. It may be visible within the orifice of the diverticulum.

Stone is readily shown by cystogram with air distention.

DIFFICULTIES IN CYSTOSCOPY

The difficulties of cystoscopy are derived from sources of urethral obstruction, bladder irritability, the presence of pus or blood, and the presence of lesions so extensive as to disfigure the cystoscopic picture.

Urethral Obstructions.—These are to be dealt with as for a passage of a sound or catheter: the meatus must be cut; a stricture dilated or cut; the prostate must be surmounted by forcible depression of the ocular end of the cystoscope.

The Irritable Bladder.—The bladder may be irritable on account of nervousness of the patient, severe inflammation or actual contraction. Sympathetic management of the individual and caudal anesthesia will overcome these difficulties in large measure. The modern cystoscope permits a fairly complete examination with no more than 20 c.c. of fluid in the bladder, though under such circumstances one may fail to catheterize the ureter.

Pus or Blood.—The presence of much pus or blood in the bladder requires a relatively thorough repeated preliminary irrigation with small quantities of fluid. If the bladder is sensitive or there are clots in it, this irrigation should be carried out chiefly by means of the irrigation vents; these admit and expel the fluid much more gently and slowly than when the opening at the end of the sheath is employed. If large clots are present, however, a few injections through the open sheath with the syringe, alternated with suction if the injected fluid does not return, must precede the more gentle manipulation. Even if the bleeding is free at the time of the examination, a fairly satisfactory exploration may still be made by patiently going over the bladder wall bit by bit while alternating the inflow and outflow through the vents, so that the examination is made practically through clear fluid that is being injected into the bladder before contamination with blood has time to occur. This method of examination is conducted with the bladder almost empty all the time. The use of fluid at room temperature diminishes the bladder and ureteral contraction and this somewhat facilitates the examination.

Pus in the urine itself is not nearly so grave an interference with cystoscopy as blood; for the pus even though it is pure and flows quite freely from the ureter never contaminates the bladder fluid so quickly as free bleeding does. Yet the bladder that contains much pus is likely to be a gravely inflamed bladder and the object of the examination is likely to be catheterization of the ureters whose mouths are lost amid this inflammation. Under such circumstances pyuria may prove a difficulty only to be surmounted by meatoscopy after indigo-carmin injection.

CHAPTER VIII

URETER CATHETERISM

The object of ureter catheterism is, first, to obtain separate specimens of urine from the two kidneys; secondly, by means of wax bulbs to detect the presence of stone or stricture in the ureter; thirdly, to permit pyelography and ureterography; fourthly, for treatment.

The complete study of a urological case may well include all of these. It requires a stay in hospital for twenty-four hours, and, if acute pyelonephritis results, perhaps several weeks. It implies coöperation between radiologist and urologist. It may invoke the wisdom of the internist or the assistance of pneumoperitoneum. It is both perilous and injudicious to attempt such a study in the office of the physician or in the out-patient clinic. Certain large clinics, it is true, attempt such study upon ambulatory patients, and the mere catheterism of the ureter is of course entirely feasible as an office procedure. Yet even this is often followed by distressing renal colic. I have known death to result from mere cystoscopy. Pyelography adds to the inconvenience and the dangers of the procedure. Urological studies had, therefore, best be made in hospital, though there will still be left plenty of diagnostic or therapeutic cystoscopies for office or out-patient clinic.

THE CATHETER

Size.—European urologists use larger catheters than we do. They employ rather larger cystoscopes with little or no provision for irrigation during the operation, and qualified to take two catheters of 8 or 9 F. (or, as they would say, of 16 or 18) size. In the United States we employ cystoscopes of the Wappler type almost exclusively and these will take two catheters of 6 F. or 7 F. size or one of 12 F. size, or, for the Kelly cystoscope or the panendoscope, 24 F.

In the attempt to make ureter catheterism an operation of precision, it is not unnatural to attempt to introduce into the ureter a catheter large enough to plug it water-tight. It is the practice of some clinics to use but one big Garceau catheter and collect the urine from the other kidney as it flows into the bladder. The objection to such a practice is twofold. In the first place, no catheter, however big, is guaranteed to plug a ureter (witness the eccentricities of the indwelling catheter); furthermore, and what is far worse, dependence upon the reliability of such catheterism engenders an unwarrantable faith in the precision of the quantitative deductions derived therefrom. We must found our diagnosis upon qualitative rather than quantitative analysis of the specimens of urine

obtained, *i.e.*, analysis that is sound irrespective of whether or not a little urine has escaped outside the ureter catheter into the bladder.

Hence, the precise size of the ureter catheter is of no great importance. Where circumstances permit, we use two of them rather than one. We have made many accurate observations using 5 F. catheters, though we prefer 6 F., for that size permits the routine use of at least a film of a wax bulb. We make no protest against the use of larger catheters. But we do maintain that precision in diagnosis will result only from vigilant observation of the rhythmic drip from the catheter, controlled by examination of the fluid in the bladder at the close of the operation.

Markings.—One must form the habit of attributing distinguishing marks to the "right" and "left" catheters. One may use a "plain" and a "graduated" catheter as a pair. My custom is to have the outer end of the catheter for the right ureter cut off square, that for the left cut obliquely.

The Tip.—The flute-tipped catheter (Plate II) is the best for routine use. A filiform, olivary-tipped instrument will sometimes enter the ureter after the flute-tip has failed.

The Plug.—It is well to plug the catheter with a pin to be removed only after it has been introduced into the ureter. Thus contamination with bladder contents is minimized.

The Wax Bulb.—A bulb, whether woven into the catheter or molded on to it in wax, may serve two purposes, (*a*) to detect constrictions in the canal just as the bulbous bougie detects constrictions in the urethra, and (*b*) to disclose the presence of stone by scratches upon the wax.

Wax bulbs may as conveniently be made from pure shoemakers' beeswax as from any other substance. They should be melted and cooled onto the shaft of the instrument so firmly that pressure will not dislodge them.

The bulb for detecting ureteral constriction is usually placed just back of the eyes of the catheter and is usually made of considerable size (*e.g.*, 14 to 16 F.). A bulb of this size will not go into the ordinary cystoscope, but if the panendoscope is not at hand the bulb may be introduced into the bladder and threaded into the cystoscope, which is then introduced with the catheter as guide. If this maneuver is to be employed, a little experimentation should be done beforehand to be sure that the bulb is of such a size and in such a situation that it does not obstruct the view of the end of the catheter.

The wax bulb for the detection of stone may be much smaller. I frequently employ a No. 5 olivary-tip catheter with scarcely more than a thin coating of wax over the olivary tip and a second bulb of the least possible diameter just back of the proximal eye. If a drop of lubricant is passed along the interior of the cystoscope, this wax bulb will slide readily in and out. The flat marks upon it from contact with the metal of the cystoscope are readily distinguished from the clawlike scratches left by a stone.

The detachment of a wax bulb in the ureter is an accident of no moment. Whatever is lost in the ureter comes out. I have thus recovered wax bulbs, a

broken-off tip of a catheter, even a metal bulb. In no instance has the passage of these relatively smooth objects given rise to any symptoms whatever.

CATHETERISM OF THE NORMAL URETER

We assume proper sterilization and anesthesia, and that the cystoscope has been introduced and the bladder examined and the ureter mouth identified.

Introduction of the Catheter.—Having found the ureter mouth, the beak of the cystoscope is moved and turned toward it until the lens is less than a centimeter away from it (Plate III, Fig. 4).

The corresponding ureter catheter is then pushed in until its tip appears, crosses the cystoscopic field and passes just beyond it (Plate III, Fig. 5).

Then the lever is elevated enough to bring the tip back into the center of the field (Plate III, Fig. 6).

After this, levers and catheters are kept rigid while, with cystoscope and catheter acting as a solid body, the tip of the instrument is depressed until the tip of the catheter touches the mucosa just proximal to the ureter orifice.

Then, using catheter and cystoscope as a single solid instrument, it is pushed inward until the tip of the catheter distinctly engages in the orifice of the ureter and enters at least 1 cm.

With the cystoscope held very steady the catheter is now gently pushed into the ureter orifice.

If it has caught in the mucosa it is gently withdrawn, turned a trifle and reintroduced. It is quite likely to be caught anywhere in its transit through the first 5 cm. of the normal ureter. Indeed, the meatus of the ureter, like that of the urethra, has a normal double constriction, (1) where it enters the bladder wall at a distance of about 5 cm. from its orifice, and (2) where it issues from the mucosa. These are not points of true strictures but of normal irregularities in the ureter. If the flute-tipped catheter will not pass in, it must be exchanged for an olivary-tipped instrument.

Beyond 5 cm. the catheter slips readily enough up the normal ureter and reaches the kidney pelvis at about 25 cm. It will be halted by contact with a papilla of the upper calix at about 30 cm., if the kidney is normal. Such contact often excites free bleeding which interferes with subsequent proceedings and the blood is likely to clot in the renal pelvis, obstructing the eye of the catheter and inducing a severe renal colic as it passes down the ureter within a few hours after the catheterism. Worse still, a catheter coiled up in the kidney pelvis has been known to tie itself into a knot requiring pyelotomy for its release.

Therefore the catheter should usually not be introduced beyond 25 cm. If the catheter is stopped in this region, or if the urine has already begun to become tinged with blood it should immediately be withdrawn several centimeters.

The manifold difficulties encountered in passing a catheter up a normal ureter are due to precisely the same causes that make the normal urethra so full of pitfalls: too much haste, too much pushing. The ureter catheter will not, it is true,

enter "by its own weight," but it will frequently fail to enter at all beyond the intravesical portion of the ureter unless guided ever so slowly. The operator should imagine the ureteral mucosa as being furrowed by the tip of the catheter and allow plenty of time, especially in the first 5 cm. for the ridges to flatten out.

Evidence of the trauma inevitable to ureter catheterism is borne by the thousands of desquamated epithelial cells, often enough to cloud the urine, and the blood in specimens of normal urine obtained by a ureter catheter.

In short, *the mere fact that the ureter catheter fails to pass a given point is no indication that there is something wrong with the ureter at that point.* Indeed the presumption is rather to the contrary. Independent evidence, notably the ureterogram, must be had to interpret the cause of ureteral blockage.

Drawing Urine.—If no impediment has been encountered the catheter is inserted 25 cm. Its tip is then in the renal pelvis and, when its plug is removed, it should promptly begin to emit a constant succession of drops. The first fifteen should be discarded, as these may represent bladder content that has been carried up the ureter within the lumen of the catheter. After they have flowed away, a sterile test-tube is applied to the outer end of the catheter and, while this is collecting urine from the kidney, the ureter catheter is pushed in 1 to 2 cm. to give sufficient slack, and the cystoscope is turned to follow the interureteric bar until it reaches the opposite ureter. The second catheter is pushed in and the second ureter catheterized. With the two catheters thus placed in the kidney pelves, before removing the cystoscope, the rate of flow is considered, and if either catheter appears to be delivering urine with abnormal velocity, this is noted; and no further move is made until the flow shall have become more normal. Thus any retained urine in the renal pelves is emptied out and one estimates the amount of retention. But the mere fact of a rapid flow of urine does not of itself prove retention. It is usually due to reflex polyuria in a normal kidney and it may be due to reflux of urine from the bladder. To estimate this, the bladder is emptied.

If either one of the ureter catheters has not reached the renal pelvis the cystoscope will be kept in place until one is satisfied that this catheter is functioning regularly. The catheter in the ureter should emit from three to six or eight drops of urine in rapid succession with intervals of from two to ten seconds.

Removal of the Cystoscope.—The cystoscope should not be removed, for fear of accidentally dislodging the catheters, until enough urine has been obtained (about 2 c.c.) to permit microscopical examination and urea estimation. Then:

1. Turn the cystoscope beak upward. Push the catheters in until little more than the ends protrude beyond the ocular end of the cystoscope.[1]

2. Note that the lever is down. Unlock and withdraw the telescope about

[1] Certain small cystoscopes drag the catheter out with them. If such an instrument is being used, it is wise to follow Hogner's suggestion, and, using another catheter, push the end of the ureter catheter halfway down the shaft before removing the cystoscope.

3 cm. Push the protruding ends of the ureter catheters home and, as they spring outward from the shaft of the telescope, disengage their tips. Slowly withdraw telescope, resisting the egress of the catheters as well as may be.

3. Permit the bladder to empty.

4. Withdraw the cystoscopic sheath slowly and gently. If the catheters are being drawn out by being jammed in the eye of the sheath, endeavor to counteract this as soon as the tip of the instrument has vacated the bulbous urethra, by counterpressure in the perineum.

With the sheath out, the catheters may well have been withdrawn somewhat. The marking on the catheter at the meatus, of the male, indicates the depth at which it still lies in the ureter, unless there is still some slack coiled in the bladder.

Further Collection of Urine.—First relieve the patient from his uncomfortable position. Then resume the collection of urine for phenolsulphonephthalein estimation and culture or guinea-pig inoculation.

Whatever the final arrangements, the separate urines are collected in two properly labeled sterile tubes. As soon as the rhythmic flow of urine has been assured an intravenous injection of 1 c.c. of 6 per cent phenolsulphonephthalein solution is administered.

The time of injection is noted and a square of gauze moistened at several points with a few drops of alkaline, sodium bicarbonate or soap, solution. After two minutes have elapsed, a drop of urine from each catheter is let fall on the alkali and this is repeated every half minute until the cerise color of alkaline phenolsulphonephthalein appears; then the catheter tips are transferred to two test-tubes and the regular drip from them carefully noted during the ten minutes allotted for collection of phenolsulphonephthalein.

Then a few drops of urine for culture are dropped directly into centrifuge tubes or a few c.c. set aside for guinea-pig inoculation.

Pyelography and Ureterography.—Meanwhile, if a complete examination is proposed, the radiographic connections have been established, and we proceed to pyelography; after which the ureter catheters are withdrawn, and the wax bulbs examined for scratches; the operation is then completed.

Failure.—An unsuccessful ureter catheterism is one that fails to obtain enough urine from each kidney for microscopic examination and urea estimation. Other considerations are so secondary to these cardinal ones that should the catheters balk thereafter we may at most call it a partial failure.

The causes of failure are two: (1) Failure to introduce the catheter, (2) failure of the urine to flow.

Failure to introduce the catheter up the normal ureter may be due to the following causes:

1. Failure to introduce the cystoscope.

2. Failure to find the ureter mouth. The remedy is meatoscopy (page 54).

3. Failure to get the catheter beyond the normal irregularities of the intravesical portion of the ureter. The remedy is to try different catheters, the

Blasucci or the olivary tipped (Plate II); to pass them most gently, rotating them slowly as the obstacle is approached. If these fail on both sides, try again a few days later after meatoscopy; if on one side, collect urine from the opposite kidney by ureter catheter and at the close of the operation collect the urine that has flowed into the bladder for comparison. The bladder urine may be diluted by water inadvertently left in the bladder, or by extracatheter flow, *i.e.*, urine that has escaped down the catheterized ureter outside of the ureter catheter.

Failure of the urine to flow in regular jets from the catheters may be due to the following causes:

1. Catheter obstructed by pus or blood left from previous use. The remedy is obvious: clean after using, test before using.

2. Catheter obstructed by a fold of mucosa or by blood or pus in the urine. It is not easy to distinguish the cause of such failure. The catheter simply works inefficiently or not at all. To remedy this, first aspirate through the catheter, gently for fear of exciting bleeding. If this fails, withdraw the catheter about 5 cm. and gently aspirate again. Repeat this maneuver, if necessary, until the tip of the catheter is about 10 cm. up the ureter. If it still fails to deliver urine, inject about 2 c.c. of sterile water. Let 30 drops issue from the catheter before beginning to collect urine for examination. The injection of water should always be reserved as a last resort for it invalidates estimation of the concentration of urea. Should even this fail, it is well to proceed to pyelography at once, recognizing, however, that the kidney may be quite normal or there may be—

3. Atrophy, aplasia or absence of kidney.

Reflux.—Reflux of fluid from the bladder up the ureter may occur whether the duct is normal or diseased and whether it is occupied by a catheter or not. It is much less likely to happen if the patient's body is not horizontal but with the shoulders raised, as in the usual position for cystoscopy; and if the bladder is emptied as soon as the catheters are in position, reflux is minimized.

Examination of the Urine.—The first urine drawn is centrifuged and examined, both wet and stained, for pus, bacteria, casts, crystals and urea content. Some experience is required to qualify the examiner to distinguish pus and epithelial cells. A drop of acetic acid is to be added to the wet specimen to bring out clearly the polymorphonuclear pus cells. The methylene-blue stain confirms this.

Red blood-cells should be disregarded and attributed to trauma. *Renal bleeding can usually not be diagnosed by catheter but only by watching for a gush of bloody urine from the ureter mouth.*

The hypobromite test for urea is adequate since its findings are comparable for the two kidneys.

Complications Following Ureter Catheterism.—The first cystoscopy is often followed by much bladder irritation for a day or so. Women suffer physically less than men, though mentally they often suffer much worse, so

that one should be reluctant to cystoscope them in the office. But the oftener the cystoscopy is repeated the less it hurts, unless the bladder is gravely inflamed. The passage of the ureter catheter adds but little to the discomfort during the operation, but even if conducted with the greatest gentleness, may result in renal colic or acute pyelonephritis. The after treatment of the operation, beyond a few hours' rest, is the treatment of these conditions. Hot sitz-baths are very soothing.

CATHETERISM OF THE DISEASED URETER

Stone, stricture and dilatation are the three ureteral diseases distinguishable by the catheter.

Stone may or may not prevent or obstruct the passage of the ureter catheter. It may or may not scratch the wax bulb. Small rough oxalate ureter stones habitually cause colic and scratch the wax. Round urate stones cause less colic and little or no scratch.

The importance of ureter stricture is not yet determined. That a catheter will not pass a certain point is no more evidence of stricture in the ureter than in the urethra. For either canal the sign of stricture is grasping of an instrument, especially the wax bulb, as it is withdrawn. In each case we use the term stricture quite casually, meaning an inflammatory permanent narrowing of the canal, with more or less scar tissue. The diagnosis of ureter stricture is elaborated by the ureterogram.

Dilatation of the ureter is shown by a continuous flow of urine through a catheter, the tip of which is below the level of the kidney pelvis. Continuous rapid flow from both ureters is, however, often due to nervous polyuria rather than to retention. The ureterogram proves the presence of dilatation.

CHAPTER IX

RADIOGRAPHY

It is not my province to instruct the radiologist how to obtain good pictures of the urinary tract. This can be learned only by long experience. Some radiologists obtain good pictures but interpret them rashly and inaccurately. Others get faint pictures, but interpret them with extraordinary skill. The radiologist who can be depended upon to obtain good pictures, and to interpret them with discretion, is as rare a treasure as the good diagnostician in any other branch of medicine.

Obedience to the following rules is essential to success:

1. The visibility of the kidneys, the edge of the psoas, etc., in the upper abdomen is enhanced by the small amount of gas present in the normal intestine. But an increase in this same gas, such as results from slight constipation, has quite the opposite effect. Hence the urologist will habitually get good radiograms in his office without any special preparation of the patient, while the constipated hospital bed patient should be prepared by the administration of an ounce of castor oil the night before the radiogram is to be taken.

2. The whole urinary tract should be covered no matter what the preliminary diagnosis. The urinary tract extends from the tenth rib above to the pubes below.

3. A good radiogram of the abdominal portion of the urinary tract should plainly show the tips of the ribs and of the lumbar transverse processes, and the border of the psoas muscles. If the diameter of the patient is no more than 12 inches, such a radiogram should at least suggest the outlines of the kidney.

4. A good radiogram of the bony pelvis should plainly show the tip of the coccyx, and of the iliac spines. The tube should be placed so high as to bring the prostate well above the pubic bone.

5. All radiograms should be taken in duplicate, stereoscopically.

PROSTATIC CALCULI

Prostatic calculi always contain a large percentage of lime, and always show in the x-ray plate (Fig. 24). They appear as a group of dots occupying the regions of the lateral lobes of the prostate. The larger prostatic stones may reach such an extraordinary size as to be mistaken for vesical calculi. I have several times known prostatic and vesical calculi to coexist. In some instances the vesical calculus is shown by the x-ray, in others not. The differential diagnosis is made by cystoscopy.

VESICAL CALCULI

In the diagnosis of bladder stone the cystoscope stands first, the air cystogram second, the x-ray third, in point of accuracy. Stones originating in the bladder are so often poor in lime salts as to show very badly in the x-ray unless air has been injected into the bladder, producing an air cystogram. This should be rou-

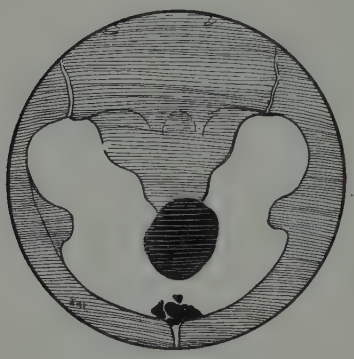

FIG. 24.—PROSTATIC AND VESICAL CALCULI

Note width of trigone between them. The large phosphatic calculus lies in the mid-line.

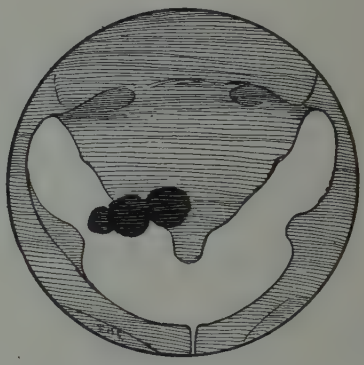

FIG. 25.—VESICAL CALCULI

The small calculi gravitate to one side. They are in contact, hence all in bladder cavity.

tine practice. It is to be noted that small stones often lie to one side of the median line, and sometimes even give the impression of being in the ureter (Figs. 24 and 25).

URETER CALCULI

The characteristics of ureteral stone as revealed by radiography are the following:

They are more or less oval in outline; the surface is fairly smooth, and they may be found in any portion of the ureter, but are most common near its two extremities.

The presence of stone in the ureter may not be disclosed by the x-ray, either because the shadow of the stone is overlaid by that of bone, feces, or other solid matter or—we know not why. Cabot has called attention to the frequency with which stones are overlooked in the region of the sacro-iliac synchondrosis and has shown that by arching the patient's back over a pillow and taking the picture at the extreme of obliquity with the tube over the patient's chest, and the plate under the buttocks, the ureters may be drawn clear of the shadow of the pelvis, and stones, otherwise invisible, may be seen. An unusually good x-ray will, however, show a stone even through the pelvic bones.

Differential Diagnosis of Stone in the Ureter.—The stereoscope is of great assistance in differentiating ureteral stone from other objects likely to be mistaken for this. The course of the ureters is shown in Figure 26. In their abdominal portions they begin one or two centimeters to the outer side of the second lumbar transverse process or thereabouts, and if normal, fall almost vertically to the brim of the pelvis where they appear to curve outward slightly, and then sweep inward well to the inner side of the spine of ischium.

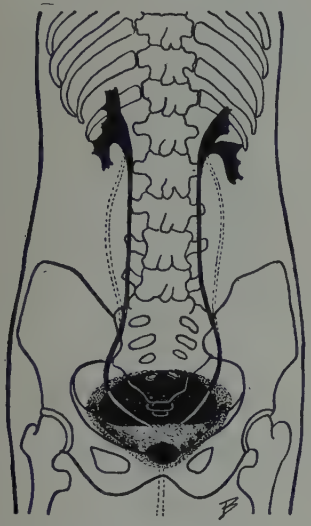

FIG. 26.—THE STONE-BEARING AREA

Kidney pelvis and ureters in black (except where ureters enter bladder). Bladder stones lie back of trigone in black "loaf-shaped" area overlying sacrum. Prostatic calculi lie just above (or back of) pubes. Phleboliths usually between this point and spine of ischium, suggested by the line of dots.

FIG. 27.—SLIGHT HYDRONEPHROSIS DUE TO RENAL MOBILITY. (UROGRAM)

Note dilatation confined chiefly to pelvis. Calices quite normal. Obstruction by adhesion of ureter to lower pole of kidney. The kink below this is not fixed. Ureter normal. Radiogram discloses a ring shadow of each iliac artery just below pelvic brim. The solid shadow lower down is a phlebolith.

An oblong shadow in the course of the ureter is likely to be a ureteral stone. But such a shadow is no more sufficient evidence of the presence of stone than the absence of such a shadow is evidence of its absence. *The diagnosis of stone must be confirmed by other physical evidence, notably by the wax-tipped catheter, urography, or evidence of renal infection and deficient function* (Figs. 27, 29, 30). Ureteral stone must be differentiated from the following:

Phlebolith, or calculus in the seminal vesicle
Tuberculous glands
Enteroliths and foreign substances in the intestines

Phleboliths (Fig. 27) may be readily distinguished by being round and not oblong, and lying near the spine of the ischium, or below it, rather than above and to the inner side of it. The diagnosis is made by urography and the wax-tipped catheter.

Not so very infrequently a sclerotic artery may be seen in the region of the pelvic ureter, either as a ring (Fig. 27) or a narrow ribbon suggesting a slightly dilated ureter.

FIG. 28.—LEFT KIDNEY ROTATED. RIGHT CONTAINS THREE CALCULI. CALCIFIED TUBERCULOUS GLANDS IN LEFT LOIN.

The angle at junction of left pelvis with lower calix is the result of rotation of the kidney which is a trifle low. On the right side the plain radiogram showed stones situated as in insert. Moth-eaten tuberculous glands, doubtless of the mesentery.

FIG. 29.—CALCULUS IN LOWER URETER. (UROGRAM)

Neither the catheter nor the injection will pass the calculus. The catheter will slip from the ureter if the cystoscope is moved. Ureterogram taken with cystoscope in place. Insert shows calculus as seen in plain x-ray, slightly smaller than the ureter about it appears when distended by the sodium bromid solution.

Tuberculous glands may well be oblong, though they are likely to be rather rounded or irregular in shape, with a moth-eaten appearance (Fig. 28). In doubtful cases the diagnosis is made as in the case of phleboliths.

RENAL CALCULI

Figures 28, 31, 32, 34 illustrate the situation, and various types of renal stone. It will be noted that in order to include all stones the photograph must at least cover the eleventh rib and the tenth interspace. If stone is suspected, but not shown by x-ray, it may be disclosed by urography or the wax bulb.

Gall-stones can usually be distinguished as round bodies, lighter in center than circumference, and situated nearer the anterior than the posterior abdominal wall (Fig. 33). Cholecystography will locate the biliary calculi in the gall-bladder. A confirmatory radiogram taken transversely will show renal calculi behind the spine, biliary calculi in front of it.

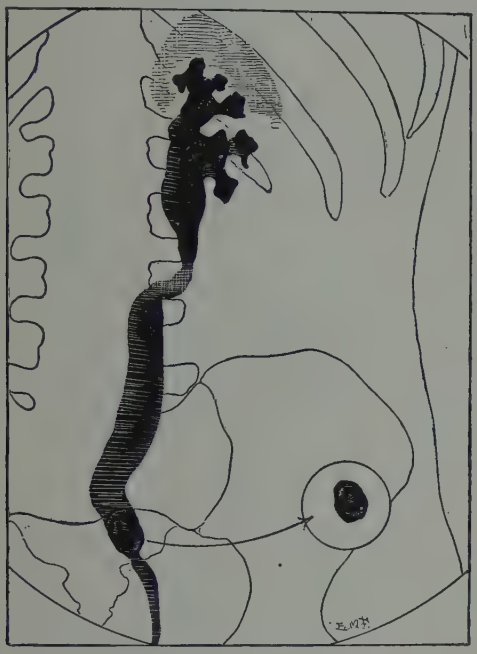

FIG. 30.—URETER CALCULUS IMPACTED AT PELVIC BRIM. (UROGRAM)

Infected hydronephrosis above it. Note blunting and shortening of calices, also apparent ureteral narrowing at the third lumbar vertebra. This is but a movable kink.

The calculus should be operated upon immediately. It is very accessible at this point. As it goes lower it becomes less accessible. It will probably never reach the bladder. If it does, the kidney function will have been destroyed. Relief of obstruction by immediate operation will permit the kidney function to return almost to normal.

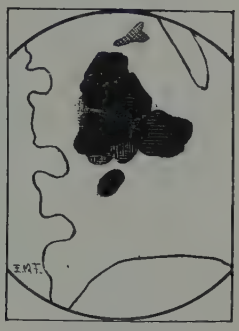

FIG. 31.—RENAL CALCULI.

No urogram needed for diagnosis. Urine from this kidney purulent and with 4 gm. urea concentration. Note the lower calculus blocking the ureter, the others taking the shape of the kidney pelvis with one in the upper calix. The kidney is low.

Urogram would show much dilated kidney pelvis and calices, probably lesser dilatation and tortuosity of abdominal portion of ureter.

It is possible that a urogram of even so straightforward a case as this might reveal some unexpected lesion; *e.g.*, papillary carcinoma of the kidney pelvis.

THE VISIBLE CATHETER AND UROGRAPHY

The visible catheter is employed to identify the position of stone or suspected shadows in the ureter and kidney pelvis.

But we go further than this, and inject into the ureter and kidney pelvis a solution or suspension of some salt, opaque to the x-ray, thus to exhibit mis-

placement and deformities of this portion of the urinary channel. This is urography (Plate V, Figs. 28, *et seq.*).

Urography is employed in the diagnosis of almost every type of surgical disease of the kidney and ureter. It is especially valuable in the diagnosis of renal retention, tumor, tuberculosis or stone; ureteral retention, stricture or stone. Stones otherwise invisible are disclosed by urography by the distention they produce in the pelvis or ureter or even by appearing as a light or "negative" area in the injected fluid (Fig. 34).

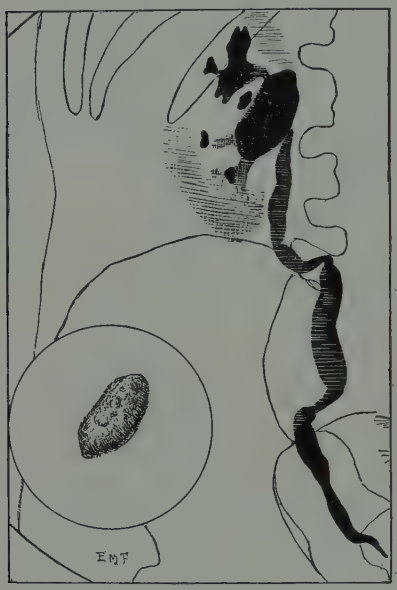

FIG. 32.—RENAL MOBILITY AND CALCULI. (UROGRAM)

Various calculi have passed, causing dilatation of the ureter in all its diameters. Slackness of ureter added to by renal mobility. Silent calculus in kidney pelvis. Back pressure beyond this has been slight, hence calices not dilated.

FIG. 33.—UROGRAM OF NORMAL LEFT KIDNEY WITH UNUSUALLY LONG CALICES. SIMULTANEOUS CHOLECYSTOGRAPHY LOCATES GALL-STONES.

Gall-stones show as a cluster nearer the mid-line (and further from the back) than if they were in kidney pelvis.

Compare shape of kidney pelvis with those shown in Pl. V.

The capacity of the normal kidney pelvis is less than 10 c.c., usually about 7 or 8 c.c., rarely as little as 3 or 4 c.c. The capacity of the infant's kidney pelvis is 1 c.c up to two years, 2 c.c. up to five years, 3 c.c. up to eight years, 4 c.c. up to fourteen years, adult thereafter.

Solutions Employed.—Collargol, argyrol, argentide, thorium, have had their day. The ideal solution for urography is sodium iodid or bromid, the potassium salts being too irritating, in strength of about 15 per cent. Higher concentrations are objectionable as too irritating.

PLATE V.—UROGRAMS OF UNUSUAL TYPES OF THE NORMAL KIDNEY PELVES.

Fig. 1.—Normal kidney pelvis, "spider-shape."

Fig. 2.—Normal kidney pelvis. The upper calix suggested a deformity due to tumor and as the patient, a fifty-year-old man, had repeated hematurias, the kidney was removed and no tumor found.

Fig. 3.—Normal kidney pelvis, after nephropexy which had rotated the kidney and had not elevated it.

Fig. 4.—Normal kidney pelvis. The major calices unite outside the kidney.

Fig. 5.—Normal calices, uniting outside the kidney without forming a pelvis. (Eisendrath).

Fig. 6.—Normal kidney pelvis. The major calices unite outside of the kidney.

Fig. 7.—Duplication of the ureter. The upper pelvis is often small and without calices.

Fig. 8.—Duplication of the ureter, pyonephrosis of the lower pelvis. Note dilatation and clubbing of calices.

Fig. 9.—Duplication of the ureter, rotation of the kidney. The lower pelvis of the rotated kidney looks dilated but is not.

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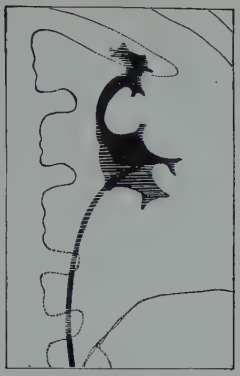

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Technic.—The operation requires only a rubber tube about 50 cm. long fitted at one end to the tip of the barrel of a 10 c.c. syringe, at the other to a rubber tip whereby it is attached to the ureter catheter.

Urograms may be obtained with the catheter tip low down the ureter but better pictures will be had if the catheter is high, with the pelvis drained of urine.

The receptacle is filled with 15 per cent sodium iodid solution. The tube is filled by gravity and attached to the ureter catheter. The receptacle is now

FIG. 34.—UROGRAM OF NORMAL KIDNEY PELVIS.

The lowest calix contains a "negative" calculus.

The insert shows the size of the stone removed at operation. Previous to the urogram this stone had been quite invisible. On the plate it showed as a thinning of the solution and a corresponding dilatation of the calix. Such stones are not excessively rare.

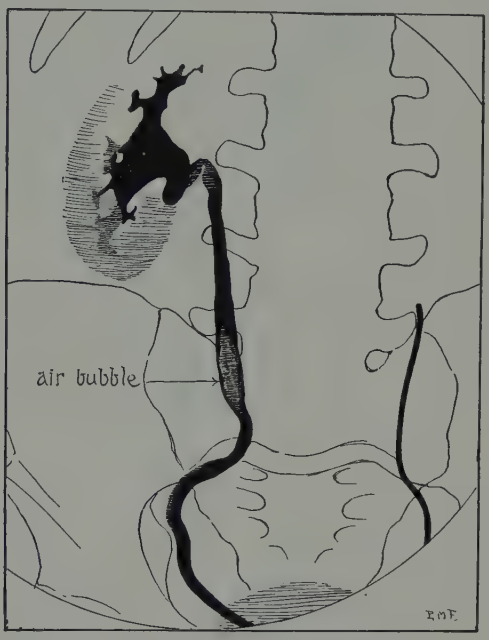

FIG. 35.—UROGRAM OF MOVABLE KIDNEY.

Visible catheter 20 cm. opposite ureter. Some fluid has regurgitated into bladder. Note air bubble simulating calculus. Kink at upper end of ureter does not obstruct sufficiently to cause renal dilatation and was relieved by nephropexy.

held as high as the short rubber tube will permit, not more than 2 feet above the kidney pelvis. If there is no bubble of air in the liquid column this immediately but slowly falls as the fluid flows into the kidney pelvis. Watch closely and the fluid will be seen to stop for an instant as the pelvis fills. For the first urogram, no more than 6 c.c. should be injected. The next step depends upon whether there is renal retention of urine or not. If not, no effort need be made to recover the solution that has been injected into the kidney pelvis. The catheter is immediately withdrawn until its tip is 10 cm. up the ureter, then about 2 c.c. more are injected, the catheter withdrawn entirely, a second x-ray

taken and ten minutes thereafter a third x-ray, this last being a check to prove that the pelvis and ureter are emptying themselves without obstruction. If they are normal, this third pyelogram should show no fluid remaining.

But if there is retention, one has to fear secondary infiltration (see below) and the fluid injected into the kidney pelvis should be withdrawn immediately the first x-ray exposure has been made in order to minimize the trauma and the danger.

FIG. 36.—LIPIODOL UROGRAM OF A HYDRONEPHROTIC KIDNEY.

The obstruction at the brim of the pelvis is shown but the fluid is too viscid, the result futile and futuristic.

FIG. 37.—RUPTURE OF URETER AT SITE OF IMPACTION OF CALCULUS.

Note extravasation, dilatation of pelvis, blunting and shortening of calices. Such a picture as this is obtained when the stone has caused gangrene and rupture at the point of impaction. Or the rupture may be due to brutal ureter catheterism. Immediate operation is indicated.

Urograms may be made even though the catheter can only be introduced 5 or 10 cm. but such urograms should not be made upon kidneys known to be in retention for the injected fluid cannot be recovered.

I do not perform bilateral pyelography simultaneously.

If performed in this manner and only upon one kidney, not hydronephrotic, the complications of pyelography will be few. But if one waits, as is usually done, until the patient complains of pain in the loin, as he will the moment the pelvis becomes overdistended, severe renal colic and acute pyelonephritis may ensue.

Dangers of Urography.—Urography is a dangerous procedure. A number of deaths due to acute renal infection or to suppression have been reported from it, and many more unreported.[1] The kidney is damaged in one of two ways:

1. The kidney pelvis is overdistended by the injection. The injected fluid is driven into the kidney tubules and lymphatics. Thence it radiates throughout the kidney, producing cone-shaped areas of necrosis or infection, in case the kidney is infected. Hinman, from his experimental work, believes this absorption to be venous.

2. Secondary infiltration occurs in hydronephrotic kidneys, due to retention of the injected fluid by closure of the ureter from the trauma of catheterism. Figure 37 illustrates such an infiltration, occurring in spite of the fact that the patient felt no pain either at the time of injection or thereafter. The patient's life was saved by nephrectomy three days later.

A mild pyelitis, characterized by infiltration and edema of the mucosa and even of the whole pelvic and ureteral wall and by submucous hemorrhages is frequently noted, in kidneys removed shortly after urography.

Hence the following rules:

Rules of Urography.—1. Never urograph both kidneys simultaneously.

2. Never urograph a palpably hydronephrotic kidney unless prepared to operate promptly. The diagnosis of hydronephrosis of any size can be readily made by noting the amount of fluid that flows immediately from the catheter when it reaches the kidney pelvis.

3. Never inject by syringe, always by gravity.

4. Watch the inflow of fluid closely to observe the moment that the pelvis is filled, before the patient feels the pain of overdistention.

5. Keep the patient in bed for at least four hours after urography.

6. Look for a reaction in the shape of a renal colic at any time within two days after the examination.

PYELOSCOPY

Urography inevitably produces upon the mind the impression that the kidney pelvis and ureter form an excretory canal of fixed caliber and position. Pyeloscopy, as Legueu terms it in his admirable monograph, on uroscopy, is the observation by means of fluoroscopy of what the kidney pelvis and ureter do in process of emptying themselves of the injected fluid. Pyelography gives fixed anatomical pictures, pyeloscopy gives a moving picture of the physiology of evacuation of the renal pelvis and ureter. Pyeloscopy is too young for us to prophesy what its ultimate usefulness may be, but a perusal of Legueu's book sheds much light upon what one actually sees by urography and introduces a new physiological light upon the physiology of renal evacuation. The following paragraphs represent a brief summary of our indebtedness to him.

By pyeloscopy one may observe the normal renal respiratory excursion as well as the evacuation of the kidney pelvis, and one learns to distinguish the fixed

[1] Keyes and Mohan, *Am. J. M. Sc.*, 1915, cxlix, 30.

pathological changes from the changeable physiological ones. The normal pelvis empties at the rate of 1 c.c. per minute. This process is an intermittent one, for peristalsis begins in the kidney pelvis and calices. These contract alternately. The filled pelvis first contracts, and as it does so it distends the uppermost 1 or 2 cm. of the ureter, just as the evacuation of the stomach first distends the cap at the pylorus. This ureteral bulb in turn empties itself, in the course of from one to three seconds, into the ureter. Meanwhile the calices

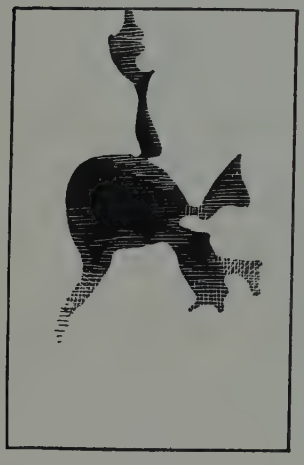

FIG. 38

FIG. 39

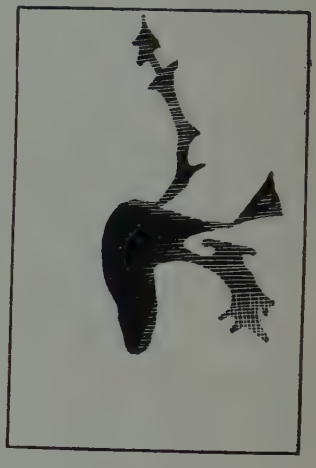

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FIG. 42

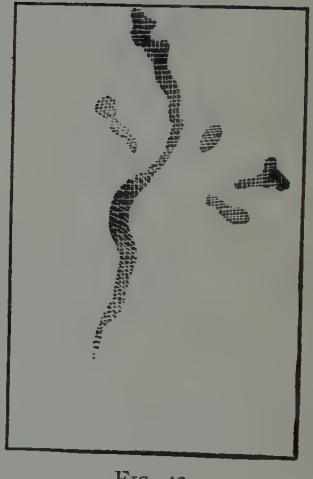

FIG. 43

FIGS. 38-43.—PYELOSCOPY. (After Legueu)

Fig. 38.—The pelvis and calices have been injected.
Fig. 39.—The pelvis contracts. Part of its fluid distends the upper calix.
Fig. 40.—The calices contract, the pelvis distends.
Fig. 41.—The pelvis contracts, part of the fluid distends the lower calices.
Fig. 42.—The calices contract, the pelvis refills.
Fig. 43.—The fluid becomes diluted with urine.

contract, emptying their contents into the pelvis. Then the peristaltic wave passes to the pelvis again; it contracts and this time visibly forces its contents both into the calices and into the bulb. Thus alternate contractions of pelvis and calices finally empty the whole into the ureter. Figures 38 to 43 illustrate this peristaltic action. They also illuminate many of the radiographic pictures that are familiar enough in fact, but have been hitherto somewhat obscure in interpretation. Indeed all urograms should be read with these simple pyeloscopic findings in mind.

That pyeloscopy may help to distinguish the fixed deformations of the kidney pelvis due to hydronephrosis from the temporary physiological ones is suggested by Legueu and it is to be hoped that others may confirm his observations. It is especially to be hoped that the method may prove of value in the differential diagnosis of ureteral stasis. Legueu's one striking observation upon this subject is that he has seen no ureter strictures.

CYSTOGRAPHY

Radiography of the distended bladder is undertaken for the diagnosis of the following conditions:

1. Diverticulum of the bladder
2. Ureteral reflux.
3. Tumor or stone in the bladder.

For the first two, a 5 per cent solution of sodium or silver iodid is employed. Stronger solutions irritate the bladder, which is much more sensitive than the kidney pelvis, and give no better pictures.

The bladder should not be fully distended. As a routine, one employs about 150 c.c. (Fig. 44).

Radiograms of diverticula should never be taken in the midline as the bladder then overlies and hides the diverticulum. They may be taken at the usual stereoscopic angle (Figs. 44, 46, 47, 48).

Radiograms of the ureter, especially the dilated ureter, may sometimes be obtained by the same technic. One cannot prophesy with any certainty what ureter, normal or dilated, will permit reflux of bladder contents.

Tumors of the bladder show very well by radiogram if the bladder is filled with air (Fig. 49). The attempt has been repeatedly made to outline diverticula and tumors more clearly by a combination of air and visible solution injections. The result is not infrequently a rather more dramatic representation of something that can be sufficiently well discerned without the complication of the double injection.

It is to be noted in reference to tumors that many of the most malignant growths do not show any change by cystogram, for the tumor is so flat against the bladder wall that it is distinguished by palpation before it is visible as an encroachment upon the bladder cavity. When a method of bladder examination

FIG. 44.—CYSTOGRAM.

Normal bladder. If the prostate were enlarged this would project from below. If the uterus were pregnant this would depress the vault. In this instance a small phlebolith is seen to the left and a larger shadow just over the spine of the ischium. To the right suggests a calculus or a diverticulum. Confirmatory cystograms prove it also a phlebolith.

FIG. 45.—CYSTOGRAM.

Six months after prostatectomy; the bladder in strangury, utterly cramped, the prostatic cavity widely dilated. Cured by antispasmodic decompression, followed by daily irrigation with weak potassium permanganate solution.

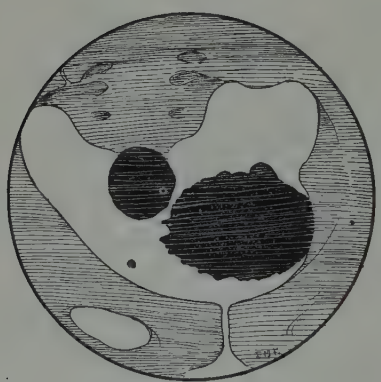

FIG. 46.—STEREOSCOPIC CYSTOGRAM.

I.

The smaller diverticulum hides, the larger one appears and seems separate from the bladder. A small phlebolith appears. The x-ray tube is to the right of the midline.

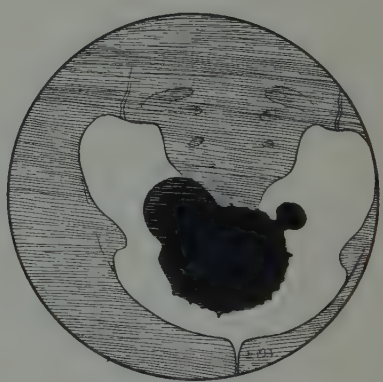

FIG. 47.—STEREOSCOPIC CYSTOGRAM.

II.

The bladder shows slight spasm. A small diverticulum to left is exposed, a larger one to the right hides behind the bladder.

The x-ray tube is to the left of the midline.

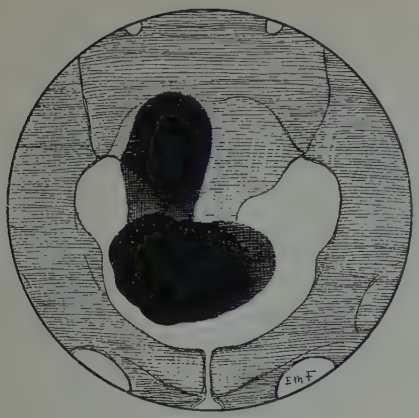

FIG. 48.—CYSTOGRAM SHOWING PSEUDODIVERTICULUM.

This bladder when opened was entirely normal. Cystograms with different degrees of distention will obliterate the pseudodiverticulum.

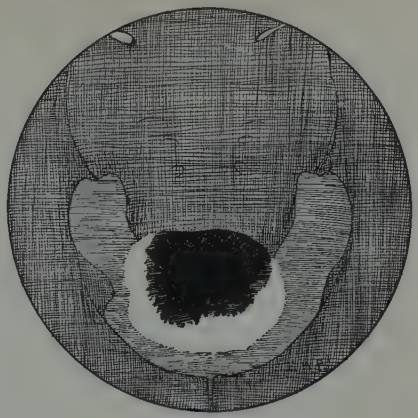

FIG. 49.—AIR CYSTOGRAM OF BLADDER TUMOR.

The tumor is a papillary carcinoma growing from several pedicles in the fundus—if it grew from the roof, it would appear nearer the pubes.

comparable to pyeloscopy shall have been perfected, this will doubtless detect regional immobilization of the bladder by such tumors.

Bladder stones are visualized by air cystography.

PNEUMOPERITONEUM

Pneumoperitoneum consists in radiography of the abdominal cavity after it has been distended with gas. Air should not be employed as it is absorbed very slowly and causes grave abdominal cramps and disturbances of respiration and circulation that may result in syncope and death. Carbonic acid gas, on the contrary, is absorbed so readily that it occasions no inconvenience to the patient. The injection should be made by the technic employed for paracentesis and with the patient on the radiographic table. Radiograms may be taken at various angles.

The method is chiefly used in the diagnosis of obscure tumors within the loin. It may be combined with urography.

INJECTION OF OXYGEN INTO THE PERIRENAL SPACE

Oxygen introduced through a needle into the perirenal fat so infiltrates this that subsequent radiograms give a remarkably clear outline of the kidney, even showing the suprarenal capsule.

Carelli introduced the method. Several deaths have resulted from it. I have employed it a number of times with grave misgivings and have once caused acute renal suppuration by puncturing a tuberculous kidney.

CHAPTER X

THE RENAL FUNCTION

Estimation of the renal function forms an important element in the diagnosis of almost every disease of the urinary organs. Yet no method of estimating this function can claim to be wholly accurate or all embracing. Hence, perhaps, the accumulated confusion resulting on the one hand from overenthusiastic praise of some one method, and on the other from undue pessimism in regard to all. Any attempt at exhaustive evaluation of all the methods advocated at home and abroad would but add to this confusion. We shall rest satisfied with a description of the methods employed by the majority of American urologists to-day.

To this end we make two postulates:

1. In the first place, the following description refers exclusively to surgical diseases of the kidney. Non-bacterial chronic nephritis does, it is true, frequently complicate the clinical picture of surgical renal disease—infection, retention, tumor; but the tests that most accurately measure the renal function in the latter class of cases are singularly inaccurate in "medical" cases. Furthermore, the test of renal function in Bright's disease is at once so complicated in its technic and so indefinite in its prognostic conclusions that we feel doubly justified in neglecting it.

The object of the urologist in making a test of renal function is not alone to measure the existing impairment of function, but also and especially to estimate whether the kidneys will continue to function under the added strain of a proposed operation, often an operation upon the kidney itself. Thus, to the urologist, the term "normal renal function" connotes a normal ability of the kidneys to carry an overload, *i.e.*, a normal reserve of flexibility. Yet here we exaggerate. Physiologists tell us that two normal kidneys have a functional capacity equivalent to four times the normal body requirement. So inaccurate are our function tests, however, that after nephrectomy the normal remaining kidney has been shown by Foster to respond quite as two normal kidneys would to the most searching of the tests employed by the internist, with the one exception that an overdose of urea taken by mouth is more slowly excreted by one normal kidney than it would be by two. Similarly, Mohan and I have found that the normal kidney remaining after nephrectomy excretes in the first fifteen minutes after intravenous injection of phenolsulphonephthalein twice as much of the dye as would one of a pair of normal kidneys.

On the other hand, this same "phthalein" test is very sensitive to bilateral renal disease or to disease of each kidney as analyzed by ureter catheterism.

2. In the second place, in the interests of brevity and lucidity we must take for granted a comprehension of renal physiology and also omit a description of many of the methods of estimating renal function. Among these methods many have so definite a value that a brief excuse for this omission is called for.

Thus "Ambard's constant," so much lauded by the French, is not used in the United States. It lacks supreme accuracy; it requires a relatively complex series of observations. Indeed, any "constant" founded upon a mathematical grouping of figures derived from simultaneous analyses of blood and urine assumes as true that which is false, viz., that "simultaneous" in this case means anything. For the blood chemistry can only show us what the kidneys have been doing, while urinalysis tells what they are doing. An acute derangement of renal function may destroy all relation between these two sets of figures.

Estimation of the freezing point, whether of blood or urine, has similar defects. The freezing point of any solution, be it noted, measures the number of its molecules, while the specific gravity measures their weight.

"Experimental polyuria" and oliguria are but practical applications of the lack of adaptability so characteristic of the diseased kidney, and upon which we shall have occasion to insist. Indeed a study of this phenomenon forms the basis of our observations. But nothing has been gained by formal observance of the details either of experimental polyuria or of experimental oliguria.

Phlorizin, methylene-blue, and many other substances employed for "artificial elimination" tests have been eclipsed by phenolsulphonephthalein.

Intravenous injection of indigocarmin for meatoscopy has a definite value.

THE IMPAIRED RENAL FUNCTION

With these postulates granted let us survey the two striking characteristics of the impaired renal function. These are:

Diminished excretion of solids
Lack of flexibility

Diminished Excretion of Solids

The elimination of excrementitious solids in watery solution is the cardinal function of the kidney. The gravity of any disease of this organ is measured best in terms of lack of efficiency in this, its excretory function. But this function is a very complex one. No test or combination of tests measures it with precision. Yet impairment of excretory function by infection is measured with a fair degree of accuracy by the excretion of urea, a little less accurately by specific gravity, by blood nitrogen and by the phenolsulphonephthalein test.

Urinary Estimation.—*The total twenty-four-hour quantity of urine,* if between 1,000 and 2,000 c.c., does not tell us much; but it exceeds these limits

only because of an unusual excess or diminution of the intake of fluids, excessive perspiration or an impairment of kidney function.

Pathological oliguria may mean obstruction to the outflow of urine, acute congestion of the kidney, as in acute Bright's, or grave chronic impairment of kidney function.

Polyuria is characteristic of certain types of chronic renal congestion, as in tuberculosis, stone, prostatism, retention. The polyuria of nervousness, of arteriosclerosis, or of other non-surgical conditions does not concern us.

The total quantity of urea passed for twenty-four hours should exceed 35 grams, 40 grams being regarded as normal. Physiological variations in the total urine do not materially affect the total urea. But disease of the kidney reduces it. The diminution of total urea is not, however, a good index of surgical renal disease. Psychasthenia, for instance, may reduce it to 30 grams, or even less.

The concentration of urea in urine, in grams per liter, is in one sense an indication of health. For the diseased kidney shows its reduction of function very largely by its inability to concentrate solids. More fluid is required to wash the solids through, as it were, and the resulting polyuria may be regarded as compensatory. Hence the concentration of urea by a diseased kidney is always relatively low. There are many physiological agencies that interfere with urea concentration. Thus a very dilute urine may be passed as the result of nervousness, or of drinking large quantities of fluid, or of arteriosclerosis, quite independently of the condition of the kidney itself. Hence lack of urea concentration is no evidence in itself of disease of the kidney. On the other hand, the presence of urea concentration is an evidence of health of the kidney. A urea concentration of more than 18 or 20 grams to the liter is evidence of a sound kidney.

But urea estimation of the specimens obtained separately from the two kidneys by the ureter catheter is of the greatest value. The urine passed simultaneously by two normal kidneys should show a urea concentration which is either absolutely equal or varying not more than 5 per cent, *i.e.*, 1 gram in 20.

In view of the inaccuracy of quantitative ureter catheter findings it is prudent to consider urea percentage, which is the only observation not vitiated by the leakage of urine alongside the ureter catheter, and much more accurate than urea volume or phenolsulphonephthalein percentage. If all tests agree, or if the urea volume or the phenolsulphonephthalein percentage vary in the same sense, but to a different degree from urea percentage, the accuracy of the observation is confirmed. But if they disagree, we may have grave doubts as to whether some technical error has not vitiated our conclusions.

Retained Nitrogen.—When the kidney function is so impaired that it falls permanently behind the demands of the organism for urea excretion, several phenomena result; loss of flexibility in renal function, loss of the renal capacity to excrete concentrated urine, nocturnal polyuria and the accumulation of excrementitious substances in the blood.

Note that normal urea concentration in the urine varies from hour to hour under the influence of diverse combinations of exercise, perspiration, eating and drinking and is, in general, distinctly less by day than by night. Thus, for example, a man with normal kidneys passes at 9 P.M., after dinner, a urine distinctly more dilute than he passes at 7 A.M., before breakfast, and if twelve hour specimens are collected, the total urine passed by day will be found greater in quantity and less in concentration than that passed at night.

Impairment of kidney function changes all this. The night urine increases in quantity, from about 300 c.c. up to 1,000 or even 2,000 c.c., and becomes less dense than the urine passed by day. The day urine also, but to less degree, is diluted and the hour to hour fluctuations diminish or disappear. The kidneys are falling behind, as it were, and straining by means of an increased output of water to keep up with their task of excreting solids. The resultant lack of flexibility will be discussed below. For the moment we are concerned with the blood changes that result.

The excrementitious substances accumulate in the blood. This accumulation can be measured. It has been found most profitable to study the nitrogenous compounds. The normal blood content of the more important of these is the following:

Non-protein nitrogen[1]: 30 to 45 mgm. per 100 c.c.
Creatinin: 1 to 1.8 mgm. per 100 c.c.

As a result of renal insufficiency the increase in non-protein and in urea nitrogen run quite parallel. Hence the estimate of either suffices. The creatinin retention is rather slower to rise, and is slower to fall, hence a rise in creatinin is distinctly more ominous in prognosis.

While it is unsafe to lay down absolute rules, the following may serve as general indications of the significance of blood chemistry in the prognosis of renal insufficiency due to surgical disease of the kidneys:

1. Nitrogen retention indicates what *has* happened. Urea concentration in the urine, as well as phenolsulphonephthalein excretion, indicates what *is* happening. Thus the two should be studied together. Adequate urea excretion may promise the relief of even a considerable nitrogen retention.

2. Nitrogen retention has, therefore, its least significance when it is the result of an acute relievable renal retention. For example, calculous anuria lasting several days may accumulate a urea retention of 200 mgm. and a creatinin retention of 5 mgm. Yet the surgeon performs bilateral pyelotomy with every expectation of cure through the subsequent adequate function of a relatively normal renal parenchyma.

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[1] The urea nitrogen runs so nearly in proportion to the N.P.N. that it is customary to estimate the urea nitrogen by the following formula: At or below N.P.N. concentration of 40 mgm. the urea N. concentration may be found by subtracting 18. With each increase 7 mgm. in the N.P.N. concentration, add one to the amperical number 22. Thus, if N.P.N. concentration is 40, urea N. concentration is 40—22=18; if N.P.N. is 61, urea N. is 61—25=36.

3. Chronic retention, however, reaching only half the above figures may be most ominous, if the renal parenchyma has been in large part destroyed.

4. The administration of water by mouth, by rectum or subcutaneously, is our mainstay in assisting the kidneys to get rid of the accumulated waste products.

No accumulation of non-protein nitrogen or urea nitrogen in the blood need, in itself, be looked upon as justifying a fatal prognosis. But very few patients survive an accumulation of more than 5 mgm. of creatinin. I have witnessed but three such survivals.

Phenolsulphonephthalein.—The "phthalein" test, as it is commonly called, stands supreme among the artificial tests of renal function merely for practical reasons. The dye is almost entirely excreted by the kidneys, and its concentration in the urine is easily and accurately measured. It is an accurate check on the inferences to be drawn from the study of urea excretion and of the loss of flexibility in the renal function.

The test was introduced by Rowntree and Geraghty.[2] A 6 per cent solution of phenolsulphonephthalein is sold in 1 c.c. ampules. The kidney function of a person, known to empty his bladder, is estimated as follows: 1 c.c. of the solution is injected into the muscle of the lumbar or gluteal region. The time of injection is noted precisely. Ten minutes later the patient is made to urinate. If the renal function is normal the phenolsulphonephthalein output will have just begun, and the urine, if acid, will be of an abnormally bright yellow color. The addition of a few drops of sodium hydrate solution, or other alkali, to this urine changes its color to a bright cherry red.

One hour later the patient urinates again. This urine is diluted to 1 liter and a few drops of 5 per cent sodium hydrate solution added to it render the urine alkaline and bring out the cherry red color. The urine is then measured in the colorimeter. At the end of a second hour the patient urinates again, and the urine thus obtained is alkalinized and measured in the same way.

It will be found that the normal kidney begins to excrete phenolsulphonephthalein within ten minutes, eliminates at least 40 per cent of the amount injected within one hour—usually 50 per cent or more—and in the second hour 10 or 20 per cent more. The normal total for two hours is at least 50 per cent; the usual return 60 to 70 per cent, and it may rise as high as 80 per cent. Rowntree and Geraghty insist that the patient shall drink several glasses of water during the test. This has the advantage of filling the bladder with enough water to insure the patient's ability to urinate at the end of each hour.

The following precautions are to be noted in reference to pathological cases:

1. If the urine contains much pus it will become very ropy on addition of the alkali. Therefore the alkali should not be added until after the urine has

[2] *J. Pharmacol. Exper. Therap.*, July, 1910. *Cf.* also Keyes and Stevens, *Am. J. Urol.*, Oct., 1911, vii, 367, and *N. York M. J.*, June 1, 1912.

been diluted. The pus is diluted with the urine and the resulting ropiness does not interfere with the correct estimation.

2. Blood in the urine is a rather serious impediment to exact estimation. Nevertheless, if the urine is permitted to stand for a while before being diluted, the blood-corpuscles will settle to the bottom of the glass, and the supernatant fluid may then be used with a fair degree of accuracy.

3. If the patient does not empty his bladder, it is of course necessary to catheterize.

4. If the output of phenolsulphonephthalein is much delayed, it may be found that it does not appear in the urine at all for half an hour or even an hour after injection; and even longer delay sometimes occurs, but in that case the total output in any one hour is never more than a trace. In such cases the output for the first hour is usually approximately the same as that of the succeeding hours. Exceptionally the kidneys delay the output of phenolsulphonephthalein as long as an hour or so and then excrete a relatively high percentage, as much as 35 per cent even, in the first hour, and very little in the succeeding hours. In such cases the delay in output of phenolsulphonephthalein is not nearly so significant of bad function as the ability to concentrate the drug, when it is excreted, is evidence of good function. Consequently in such instances it is well to repeat the test, injecting the phthalein intravenously and measuring the excretion by half hour periods.

Phenolsulphonephthalein estimations are, of course, comparable not to percentages of urea, but to total urea, *i.e.,* to the amount of urea excreted during a certain period. Thus we must always bear in mind that quantitative inaccuracies in the amount of urine passed, such as result for instance from retention of some urine in the bladder or, when the ureter catheter is employed, from extracatheter flow, introduce no inaccuracy in the estimation of urea percentage but do introduce an element of inaccuracy in the estimation of total urea and of phenolsulphonephthalein percentage. Thus the urea percentage estimation of urine obtained by ureter catheter is the freest of all from the element of technical error. But, apart from technical errors, the phenolsulphonephthalein output is more sensitive than the urea percentage.

Braasch has shown that intravenous injections sometimes give much more accurate readings than injections into the muscles, and attributes this to variations in the rapidity of absorption not directly attributable to renal disease. Indeed the current practice seems to be to make all phthalein injections into a vein. Yet I cling to the intramuscular injections for routine hospital practice, except for ureter catheter estimations, because the rapidity of excretion from intravenous injection is so great that the personal equation of error is multiplied beyond the limit of safety. In my office I always employ intravenous injections.

When injected intravenously the concentration of phthalein in the urine reaches its maximum within ten minutes after the appearance of the dye in the urine. The normal kidneys excrete at least 40 per cent in the first half hour.

Estimates should therefore be made by two periods of half an hour each instead of an hour, as customary after intramuscular injections.

Phenolsulphonephthalein Excretion in Disease.—Impairment of the renal function is accurately reflected by diminution of the immediate phthalein output. The curve of excretion is lower, and the later output correspondingly high. This may be interpreted in terms of lack of flexibility by the statement that the impaired renal parenchyma cannot keep up with the immediate demand for excretion. It does what little it can to begin with and excretes the balance later. It is to be noted, however, that disease of one kidney may result in hypertrophy of its fellow to such a degree that neither the total urea nor the total phthalein excretion are perceptibly impaired. Hence the following propositions:

1. Impairment of total renal function lowers the peak of phthalein excretion and thus brings the periodic readings closer together.

2. If the excretion is reduced to between 20 and 30 per cent for the first period—an hour for intramuscular, a half hour for intravenous injection—it rises to between 10 and 25 per cent for the second.

3. If it falls below 15 per cent in the first period an almost equal amount will be excreted in the second and even in the third period.

4. The first appearance of the dye in the urine is correspondingly delayed, usually by not more than ten to twenty minutes.

5. Exceptionally, after intramuscular injection the appearance of the dye is delayed for an hour; yet the concentration of the dye in the urine may be as high as 30 per cent in the first hour thereafter. Such a reading should be controlled by intravenous injection which will usually show the renal function but moderately impaired.

6. Even total destruction of one kidney is compatible with a normal phthalein output, due to compensatory hypertrophy of its fellow.

7. A phthalein output of less than 30 per cent in the first period signifies impairment of the function of both kidneys.

Phenolsulphonephthalein with the Ureter Catheter.—The more immediate, intense and reliable excretion of phthalein following intravenous injection is as essential for the study of specimens of urine obtained by ureter catheter as it is negligible for general use. Hence *intravenous injection should always be employed.*

Mohan and I [3] have found that the output of phthalein reaches its greatest intensity almost immediately after its appearance in the urine, the maximum being in the second or third c.c. unless the urine is very dilute—usually within the first five minutes, and always within the first ten. This concentration may reach as high as 6 per cent per c.c. But the reflex polyuria so common in nervous individuals may keep the maximum concentration down to 1 per cent per c.c., even though the kidneys and the total phthalein output be quite normal.

[3] *J. Am. M. Ass.*, 1921.

The general rules governing the excretion of phthalein from normal kidneys, as studied by ureter catheter, are the following:

1. The dye appears in from two to six minutes after intravenous injection.
2. The maximum intensity of excretion occurs in the first ten minutes.
3. Each normal kidney excretes at least 1 per cent of phthalein per minute for the first fifteen minutes.
4. A diseased kidney cannot concentrate 2 per cent of phthalein in a c.c. of urine.
5. Yet a normal kidney exhibiting polyuria may not concentrate even 1 per cent per c.c.

It is my custom to collect urine for phthalein concentration for no longer than ten minutes. When the output is free and intense, five minutes suffice. An output of 1 per cent phthalein per minute proves the kidney normal and large enough to support life. A concentration of 2 per cent per c.c. proves the kidney normal, but does not ensure the presence of enough parenchyma to support life. Curiously enough, a concentration, after the usual injection, of 2 per cent phthalein per c.c. of urine gives the same assurance of normal kidney function as does a concentration of 2 per cent urea.

When the kidney is diseased the changes noted in the output of phthalein, as studied by ureter catheter, are the same as those already described, viz., delay in appearance and flattening of the excretory curve. As compared with urea concentration the phthalein appears somewhat more sensitive, especially when there is hydronephrosis. Essentially, however, the two agree. Should they contradict each other markedly in a given case the examination should be repeated, greater reliance being placed upon the concentration of urea, or phthalein per c.c., than upon the total phthalein excretion.

Indigocarmin.—Indigocarmin is the best substitute for phthalein and has the advantage of being much better adapted to meatoscopy. The expert prefers phthalein. But in clinics, where cystoscopy is done by the internes, failures to obtain satisfactory ureter catheter specimens of urine have given indigocarmin the preference for routine use.

Five to 10 c.c., the smaller amount usually sufficing, of saturated (0.6 per cent) solution are injected into a vein. The cystoscope is then introduced and the ureter mouth watched until a gush of dark bluish-green urine appears. Then the opposite ureter is watched and the intensity of the colors matched. This procedure is termed meatoscopy. The ureters are then catheterized, if possible. In as much as the visible indigocarmin disappears within twenty minutes, it is possible, by timing the operation with care, to employ phthalein after the green hue has faded from the urine.

The great disadvantage of indigocarmin, as compared with phthalein, is that it is much delayed in appearance and diluted in concentration by insignificant renal insufficiency, so that it often rather distorts the picture. It is also in large measure decolorized by alkalinity of the urine and percentage readings of indigocarmin are not easy to make.

Lack of Flexibility

Barringer has justly observed that the tests for renal function are actually tests of the reserve force of the kidney; a reserve upon which the surgeon usually intends to draw to withstand the shock of operation. Power to take on extra work, flexibility in other words, is, therefore, one of the striking characteristics of the normal kidney function. This flexibility is manifested in changes from hour to hour, indeed from minute to minute, in the quantity and quality of the urine. The diseased kidney shows a marked diminution in this flexibility. Such ordinary influences as eating and drinking, perspiring, etc., excite a change in the quality and quantity of its output much less than that of its normal fellow. This lack of flexibility has been made the foundation of various tests of renal function, notably the experimental polyuria test of Albarran. He collected the urine for four half-hour periods, administering three tumblers of water at the end of the first period. The result of his test may be plotted in curves, but its accuracy by no means compensates for the length of time consumed.

Such formal and time-consuming operations are of use to the student of renal physiology. But the practitioner may, as has been already indicated, found his opinion of renal flexibility on observation of the relative quantity and density of day and night urines and variations in density before and after meals, the precision of Mosenthal being unnecessary. He will also insist that phthalein tests be done in two periods, and will have constantly in mind the fact that efficient function means reserve force.

BLOOD-PRESSURE

The fact that an increase in blood-pressure is frequently associated with chronic nephritis, though not necessarily resulting from it, is generally recognized. Hence the so-called "cardionephritis." But typical cardionephritics are not common among our surgical cases of renal insufficiency. Indeed very considerable destruction of renal parenchyma by suppuration and great restriction of the reserve of renal power, marked renal insufficiency, are quite compatible with low or even subnormal systolic blood-pressure. High blood-pressure is associated rather with retention which may only hold the renal function in abeyance, than with the suppuration which destroys it. Thus the relief of prostatic retention may be expected to reduce an abnormally high blood or pulse pressure.

CHAPTER XI

RENAL DECOMPENSATION; THE PATHOLOGICAL PHYSIOLOGY OF RETENTION; DECOMPRESSION

In the preceding chapter the pathological physiology of the kidney has been considered in terms of the validity of the tests of renal function. With the knowledge thus obtained of what these tests indicate, one may reverse the process and apply the tests as measure of renal decompensation.

The term renal decompensation should be understood, like "cardiac decompensation," to mean an impairment of renal function so grave as to reduce the renal capacity below the usual physiological needs of the individual, even in spite of any compensatory diuresis, in as much as diuresis is an attempt at an artificial compensation. Note, however, that although one has to speak of renal decompensation as though it were a fixed condition subject to quite accurate delimitation, practically this is far from the truth. Given a fixed impairment of renal function, adventitious circumstances often determine whether this results in decompensation or not. Indeed the circumstances of a given case influence the prognosis so disproportionately that it has been very plausibly argued by some that knowledge of the phenomena and tests of renal function is of no value whatever in prognosis, that one can do as well without them. It were wiser to argue, however, not that one can do so well without renal function tests, but rather than one can actually do better without them if they are to be taken as definite fixed limits in prognosis and notably in that fascinating prognosis which is the decision to submit a patient to the danger of operation. The renal function tests are not *"verboten"* signs, but "Stop, Look, Listen!" You will read that no patient survives long with a blood content of "5 mgm." creatinin, that "a zero phthalein output" forbids operation. Both statements are absurd. Indeed, the urologist who merely watches his patient is better off than such scientists as these. But the urologist who checks up the daily observation of his patient with routine laboratory confirmation will be better off than either.

One might summarize the situation as follows:

The past of renal function, *i.e.*, what the kidneys have been doing, is revealed by blood chemistry and blood-pressure.

The present of renal function, *i.e.*, what the kidneys are doing, is revealed by concentration (Mosenthal), dilution (Albarran) and excretion (phenolsulphonephthalein or indigocarmin) tests.

The natural future of renal function will be deduced by the clinician from his practical ability to prevent renal decompensation. The medical problems

in renal function are in the main chronic ones, and the internist strives to prevent decompensation almost exclusively by reducing the demands of the organism at large, in the case of overstrain or overweight, by avoiding specific poisons, such as alcohol, intercurrent diseases, etc., and by minimizing the intake of those foods, nitrogenous, saline, etc., the excretion of which is impaired.

But the problem of the urologist is habitually an acute one which consists primarily in the relief of the retention or the removal of the pathological condition, whether pyonephrosis, tuberculosis, stone, or tumor, which has upset the renal function. And to do this may require an operation, the chief risk of which is the ensuing renal decompensation.

Hence the chief conscious concern of the urologist with renal function tests is in the prognosis of operations. He has learned that the proper preparation for operations includes diuresis and gradual decompression and implies delay until temperature, blood-pressure and renal function have ceased to fluctuate, have become fixed as near normal as possible. This done, the prognosis depends upon his skill as a urological surgeon.

There are two parallel emergencies in urology, common enough to arouse sad memories. They are the following:

Case 1.—The patient is in prostatic retention. His bladder is full to his umbilicus, perhaps above it. Yet he is very little discomforted. His chief complaint is constipation and indigestion. His micturition seems to him all but normal. He is lean, but looks quite well.

The laboratory tells us: (1) Urine, specific gravity 1010, trace of albumin, no pus or bacteria; (2) phthalein output, slightly subnormal, *e.g.,* 20 per cent in thirty minutes after intravenous injection; (3) blood nitrogen within the normal limits, *e.g.,* N. P. N. 35; creatinin, 1 mgm.; (4) slight secondary anemia, *e.g.,* 4,000,000 red blood-corpuscles, 70 per cent hemoglobin.

Case 2.—The patient has an ancient extensive dense urethral stricture. He has been so brutalized by the passage of sounds that he long ago swore off local treatment. Every five or ten years he submits perforce to urethrotomy and escapes as soon thereafter as he can lay hands on his clothes. He is a pitiable figure, the victim of careless treatment by those who have unskillfully passed sounds upon him. He has perhaps an ounce of residual urine from prostatic sclerosis. He is leaner and yellower than Case 1. He too has constipation and indigestion, but these he scarcely considers in comparison with the gravity of his urinary retentions, urgencies, discomforts, hemorrhages and foul odors.

The laboratory tells us: (1) Urine, specific gravity 1010, trace of albumin, innumerable pus cells, various bacteria; (2) phthalein output, only a trace in two hours; (3) blood chemistry shows retention, *e.g.,* N. P. N. 100 mgm.; creatinin, 3 mgm.; (4) marked secondary anemia, *e.g.,* 3,000,000 red blood-corpuscles, 50 per cent hemoglobin.

To summarize: Two men of like age, with grave disease. Each has had obstruction to urination for years. Each requires operation. Case 1 scarcely

knows it. He complains of no urinary disorder. His general condition is good, his urine uninfected, his renal function fair. Case 2 knows the whole story. He is tortured and worn. His kidneys are gravely infected, his renal function bad. Which has the better chance to survive operation? Case 2.

If each dies after the operation, what will be the proximate cause of death in either case? Renal decompensation.

What are the adventitious circumstances that will determine the issue in each case? The surgeon's experience, discretion, gentleness and assiduity.

The problems of surgical prognosis are thus complex and confusing. When we set ourselves the task of unraveling them with the aid of the renal function tests, we are as often trying to prevent the patient falling into decompensation as pulling him out of a decompensation in which he has already fallen. The difficulties and dangers that beset this therapy are nowhere so completely illustrated as in the treatment of prostatic retention. Let us return to Cases 1 and 2 cited above, the one a prostatic, the other a stricture retention. Pathologically, Case 2, dilatation plus infection, with decompensation established, would seem a worse risk than Case 1, dilatation without infection and without decompensation. The actual danger to Case 1 is that any but the most expert treatment may plunge him into a fatal combination of acute renal infection, due to catheter infection, and acute congestion, due to the relief of back pressure. Each is calculated to result in decompensation, the combination has this certain result. The semblance of health of Case 1 is his danger; while the manifest illness of Case 2 so plainly invokes our every care as to be his safety.

This is not the place to discuss the detail of these special cases. They have been selected as an introduction to a study of the pathological physiology of renal function impaired by the back pressure resulting from retention of urine at any point, in the kidney calices or pelvis, the ureter, the bladder or the urethra. For the physiology of "renal retention" is the vital spark of urology. As soon as urologic therapy reaches beyond the mere relief of symptoms and aspires to save life renal retention and the effect of disease and of treatment upon it are our major concern.

Let it be stated as a preliminary, and repeated in summing up: Every phase of acute renal congestion is a phase of heightened susceptibility to infection. Retention invokes infection; so does the relief of retention. Yet, description of the pathological physiology of infection must be deferred until that of retention without infection has been completed.

We encounter in practice the following types of retention, the classic clinical examples of which are enumerated:

1. Complete retention:

In a calix, due to stone
Of one ureter, due to ligature of the ureter, or stone
Of both ureters, due to calculous anuria or bladder carcinoma
Below the bladder, due to prostatism or stricture of the urethra

2. Acute almost complete retention:
   Unilateral, due to renal colic
   Bilateral, due to prostatism
3. Incomplete chronic retention:
   Unilateral, due to hydronephrosis
   Bilateral, due to prostatism
4. And decompression is as important a cause of disturbance of renal function as is the retention it relieves
5. Finally the effect of infection upon renal retention must be noted

COMPLETE RETENTION

Of a Calix.—Retention cysts in the parenchyma of an otherwise normal kidney may, it is true, be due to stoppage in the lumen of a tubule. Indeed polycystic kidney, that disease in which the whole parenchyma of both kidneys becomes cystic, seems to be due to parenchymal complete retentions of urine. But the large solitary cysts that invite surgery, the interesting cysts of tuberculosis, etc., are examples of calix retention.

As the calix dilates, so do the tubules entering it, a flattening of their epithelia keeping pace with the dilatation. The pressure of these dilated tubules upon each other obstructs the blood flow in the veins between them, thus restricting their own blood supply, hastening atrophy in the septa and further enlargement of the cyst. The outcome is atrophy and functional destruction of that portion of the kidney which drains into the obstructed calix.

Of One Ureter.—The process, involving all the urinary channels above the point of obstruction, is comparable to that described above. The ureter, the kidney pelvis, the tubules, dilate. The pressure within the cavity, at first high, falls within a few weeks almost to zero. The fluid, at first urine, becomes more and more dilute as the excretory tubule cells become less and less able to discharge solids. The ultimate result is a shell of hydronephrotic kidney, probably not much larger externally than a normal kidney, but gutted out, a mere shell, with bulging pelvis and ureter.

The development of a kidney cyst is symptomless, except when the cyst attains such unusual dimensions as to drag or press upon the surrounding viscera. Even the death of a whole kidney by retention may excite no other symptoms than slight loin tenderness, and a mild intoxication. But this implies that the blocked kidney is not infected, the opposite kidney quite normal.

The Surviving Kidney.—If a healthy kidney is removed by nephrectomy, its surviving fellow has suddenly to assume a double burden of excretion. The immediate effect of this we do not know, for we cannot disentangle it from the operative shock. There seems to be a brief inhibition of function. The kidney staggers under its burden. If its daily excretion of urea, its total excretion of phenolsulphonephthalein is not actually diminished, at least it takes some days before it accommodates itself to this double work. During several weeks there-

after, it gradually increases its output of water and solids and finally, when it has accommodated itself to the task, it will be found to be excreting an amount of water and solids equivalent to what both kidneys were doing before the operation. It excretes in any given period double the normal amount of phenolsulphonephthalein for one kidney. Indeed, Foster found, in a study of this ultimate situation, that the surviving healthy kidney after nephrectomy answers to all known tests quite as do two normal kidneys, with the exception that it is a trifle slow in excreting large quantities of urea administered by mouth.

If the surviving kidney is not normal it is slow to take on this added burden and never quite functions up to the double normal. But its capacity to recuperate is nevertheless surprisingly good. Removal of the more abnormal kidney, when both are diseased, may cause complete decompensation of its fellow or may leave it in the long run functioning better than both together did before the operation.

Of Both Ureters.—Simultaneous complete obstruction of both ureters must indeed be rare. But simultaneous cessation of function of both kidneys produces the classical clinical syndrome known as calculous anuria. This physiologically represents a bilateral stoppage, though anatomically the block on one side is due to ureteral obstruction, on the other to acute congestion of a diseased kidney overwhelmed by its overload.

The pathological lesion has been described. The only symptom for several days is that the patient passes no urine. He seems perfectly well but for an increasing restlessness, sleeplessness, anorexia, constipation. The blood chemistry day by day shows a rising tide of nitrogenous retention until suddenly vomiting and delirium ensue and, within forty-eight hours, death.

Below the Bladder.—When the stoppage is urethral the immediate clamor of the frustrated desire to pass water dominates the picture. The spasms come in waves. A few moments of ineffectual spasm are followed by a stretching of the bladder muscle, whereby its capacity is a trifle increased, its sensitiveness a shade diminished. The intravesical pressure required to excite the desire to urinate rises rapidly from about 15 mm. Hg to a maximum of 25 mm. Hg while the bladder capacity rises to a liter or more and its apex to the umbilicus or above this. If the patient's screams bring no relief, the kidneys in a day or so cease to function, the bladder becomes more or less passive and the exhausted patient rapidly passes into the terminal phase of anuria.[1]

ACUTE RETENTION OF BRIEF DURATION

Most of the acute complete or almost complete retentions seen in the clinic do not go on to destruction of the kidney. They are relieved by nature or by

[1] There is but one exception to this rule. The combination of bladder paralysis and anesthesia characteristic of a broken back often spares the patient the pains of distention and at the same time lowers the tone of the sphincter muscles to such a degree that the overdistended bladder may be emptied by abdominal massage and the patient spared the acute—and often fatal—pyelonephritis that results from catheterism of such a case, during that brief period which precedes the establishment of the automatic bladder.

treatment. For the moment let us confine our interest to those that are relieved spontaneously.

Unilateral Brief Retention.—The majority of ureteral obstructions are due to stone or to mural impediments usually classified as strictures. It is characteristic of these latter that, as compared with ureter stone, they excite relatively less pain and result in relatively more dilatation. We therefore defer consideration of them and concentrate our immediate attention upon the characteristic brief, complete or almost complete ureteral retention termed renal colic due to ureter stone.

Why does the blocking of the ureter by stone rarely cause painless anuria but more often excite an intensely painful renal colic? Doubtless because the stone usually does not block the ureter completely. It is an ill-fitting cork. It stops the flow until the resultant pressure forces a trickle of urine past the obstruction, raising the tension, then allowing it to fall a bit only to rise again to a greater height, until the tension within the kidney pelvis rises much higher than would have been the case had the stoppage been complete in the first place. This rapid increase of tension so stretches the kidney as to cause pain, a pain quite comparable in intensity to the bladder spasm caused by complete urethral obstruction, the incomplete ureter obstruction in the one instance evoking high renal pressure, the elasticity of the bladder in the other causing high vesical pressure. In each instance it is the suddenness of the retention that stretches the viscus to the point of pain. Ureter stricture causes less pain because it obstructs less suddenly.

If the stone remains fast, the kidney accommodates itself to the tension, the colics become less severe, the renal function is destroyed, the almost complete obstruction becomes complete, painless.

But as a rule either the pressure soon becomes sufficient to dislodge the stone, free the urine, relieve the pain, or morphin is given in quantity sufficient to relax the ureteral spasm about the stone and accomplish the same result. After an interval the jam will recur again and again until relieved by passage of the stone into the bladder or its removal by operation. Exceptionally, a stone, after occasioning a number of colics becomes quiescent, "silent."

The immediate result of the relief of this, or of any other severe renal retention is an intense polyuria, the discharge of large quantities of dilute urine from the affected kidney. This, like every pathological polyuria, is an index of impaired renal function, for power to eliminate concentrated urine is the measure of normal function, and pathological polyuria is the familiar compensatory over-permeability of the glomeruli, or lack of resorption in the tubules, associated with diminished tubular permeability to solids.

Many a stormy passage of stone leaves little permanent physiological or anatomical change in the kidney once this primary polyuria has subsided. But as a rule pyelograms taken thereafter show a slight permanent widening and blunting of the calices, and of such kidneys it may safely be prophesied that they will not again form primary stone, for they have lost the power of excessive

concentration, of crystalline supersaturation, while remaining adequate excretory organs.

The function of the opposite kidney is inhibited during a colic, but to no important degree unless it too is diseased or blocked.

Bilateral Brief Acute Retention.—As already hinted, the torture of acute urethral retention is such that it is soon relieved by art if not by nature. If uninfected and promptly relieved, the immediate effect upon the kidneys is a bilateral pathological polyuria followed by more or less permanent dilatation, and in the bladder some slight dilatation and trabeculation.

INCOMPLETE CHRONIC RETENTION

Permanent complete retention, we have seen, annihilates the function of all organs "upstream," while brief almost complete obstruction temporarily disturbs function but may leave no important anatomical changes. Incomplete retention results from a partial obstruction that progresses so slowly as to excite little or no pain, yet persists so long as to cause grave permanent structural impairment of function.

Unilateral Incomplete Obstruction.—The causes of partial obstruction to one ureter are many. Stones cause as many silent partial obstructions as they do complete ones. Irregularities of urethral course and contour, *e.g.*, from renal mobility or ureter stricture, are common. Tumors within the ureter are rare, but back pressure from vesical tumor obstructing one ureter is not uncommon. The common character of such obstructions as we are here considering is a gradual onset and progress with relatively few interrupting attacks of painful, almost complete, obstruction.

The result of such incomplete obstruction is hydronephrosis, *i.e.*, dilatation of kidney, pelvis and ureter, with gradual progressive destruction of kidney parenchyma and permanent impairment of function. The pathological process is that described as resulting from permanent complete obstruction. The impairment of function is permanent and directly proportional to the cellular damage in the kidney parenchyma. Release of the partial retention results in a less spectacular, temporary and a more dramatic permanent pathological polyuria than is usually seen after release of acute subcomplete unilateral retention.

Incomplete Bilateral Retention.—Three major types of this retention may be noted, viz., those due to vesical, to prostatic or to urethral obstruction.

Vesical obstruction due to stone or tumor need not be distinguished from bilateral obstruction, due to stone, kink or stricture within the ureter.

Urethral obstruction, e.g., by stricture, results in the same pathological and physiological changes as does prostatic obstruction, but urethral obstruction, lying in the course of the urethral channel and not at its origin, does not cause incomplete retention of urine. The bladder continues to empty itself completely until it ceases to empty itself at all.

Incomplete prostatic retention illustrates in the variety of its results every one of the phenomena described in the preceding paragraphs, and especially concerns the urologist by requiring his intervention and presenting a field in which that intervention can and often does kill the patient through ignorance or inadvertence.

Prostatic obstruction whether sclerotic, with rigidity of the bladder neck, or hyperplastic, so deforms the outlet of the bladder that it causes retention, partial or complete. The following is a slight modification of Guyon's classification:

(*a*) Partial prostatic retention; the bladder can empty part of its contents but after urination there remains a "residual" urine of more than the negligible 10 to 15 c.c.

(*b*) Chronic prostatic retention with little hypertension; in this condition, the bladder is always full, but the retention has progressed so gradually as to evoke no symptoms; the patient is unaware. He urinates at intervals not far from normal, with, objectively, a dribbling stream but, subjectively, with little or no discomfort or difficulty. The intravesical pressure, though little above the normal 15 mm. Hg, is constant and progressively dilates the bladder, ureters and kidneys.

(*c*) Chronic prostatic retention with hypertension, when the increase in retention volume is rapid enough to evoke such symptoms as frequent, difficult or painful urination. The patient appeals for relief when the bladder, though stretched to its immediate limit, not yet as dilated as under (*b*), and kidney distention may be inconsiderable. But the protective mechanism in the lower ureter has been broken down and the kidneys are under the same tension as the bladder. The bladder is usually infected.

(*d*) "Acute complete" retention—this is retention with such excessively high tension that the patient, whether actually achieving in his incessant attempts at urination the passage of a few drops of urine or not, is at least in that quasi-complete condition of retention comparable to that ureteral retention termed renal colic.

Note that owing to sudden changes in the size of the prostate, the more intense types of retention, even the acute complete, may appear suddenly, may interrupt the gradual progress of an incomplete retention, and may, whether spontaneously or under treatment, recede as rapidly as they appeared. Moreover, after one or two catheterisms, infection often dominates the scene. Hence it may be difficult in a given instance to disentangle the observed physical and physiological phenomena. Careful analysis, however, will reveal the following:

Anatomical Changes in the Bladder.—Retention, even partial, causes distention. Cystoscopic inspection of the uninflamed bladder with no more than 50 or 100 c.c. of residual urine reveals, notably behind and external to the ureter orifices, trabeculations; *i.e.*, areas in which narrow interlacing bundles of bladder muscle stand out under the bladder mucosa, throwing this into folds (Plate I).

As the distention continues, it results in driving the mucosa deeply between these trabeculæ to form cellules, which show in the cystogram of every irritated bladder, or even permanent "blow outs" of the mucosa, diverticula extending beyond the bladder wall. Meanwhile, as Ciechanowski proved, the bladder wall becomes sclerotic with age and retention, quite independent of infection. This sclerosis accelerates the mucosal herniation, and unless infection intervenes to destroy elasticity, does not prevent the gradual distention of the bladder cavity to hold 2,000 c.c. or more and to distend above the umbilicus in a shape shown in the cystogram as the "false diverticulum" (Fig. 46). With great distention the muscular coat of the bladder becomes sclerotic, thin and resembling a piece of blotting paper.

Physiological Changes in the Bladder.—Overdistention and sclerosis combine to weaken the bladder muscle and to reduce sensibility. The normal bladder registers distention and evokes the desire to urinate at a pressure of 15 to 16 mm. Hg. If one resists this desire, it disappears with a relaxation of the bladder muscle and consequent fall of pressure but returns after a brief interval during which enough urine has entered the relaxed bladder from the kidneys to raise the pressure not merely to the degree that had evoked the first desire to void, but a few points higher—the very first brief voluntary retention thus exhibiting its power to blunt sensibility.[2]

The effect of bladder retention upon kidneys and ureters is similar to that occasioned by ureteral retention.

Summary.—Partial chronic retention lowers the function of both the bladder and the kidneys. Relief of the retention will reëstablish an adequate function though it is likely to leave some distention of both. The elastic bladder acts as a buffer to protect the kidneys.

Chronic retention with slight hypertension permanently dilates the bladder and the kidneys. Relief of the obstruction will repair the bladder function but will not rehabilitate the renal cells and will only reëstablish renal function in so far as removal of pressure from these cells permits them to act more normally. Chronic retention with hypertension and subcomplete acute retention add the distressing symptoms of overdistention and the acute congestion of compression and of decompression, but if promptly and efficiently relieved, they may leave behind less permanent renal damage than does chronic retention without hypertension.

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[2] How much urine is required to fill the bladder? Enough to evoke the desire to urinate. The normal bladder responds at 15 mm. The overdistended bladder needs 20 to 25 mm. pressure. The paralyzed bladder requires no more than 5 to 10 mm., but it takes a pint or more to raise the pressure to this height.

Let medical students study the increase in bladder content and pressure effected by voluntary retention if they will. But let the professor beware. Voluntary retention of urine by him may occasion acute retention, thus disclosing the existence of hitherto unsuspected prostatic retention.

The quantity of urine required to evoke these pressures varies in different individuals from 20 to 2000 c.c. The capacity of the bladder, as Guyon justly remarked, is physiological and not anatomical.

Atony of the bladder used to be much dwelt upon. As recently as 1890 no one doubted that five years of chronic prostatic retention left the bladder so atoned as to be permanently incapable of emptying itself, even after removal of the obstruction. We now know that this atony of the bladder, however marked pathologically, is physiologically of little importance as compared with the scar at the bladder neck left by prostatectomy. If the prostatic obstacle is removed and the bladder neck left elastic, the bladder will empty itself completely.

URETERAL REFLUX

Quinby and his students have shown that in certain animals the half-full bladder so stretches the ureter orifices as to permit reflux of the bladder contents up to the kidney. But when the bladder is overfilled the oblique implantation of the ureters protects them from this reflux; their orifices are pressed shut. The occasional occurrence of reflux up the normal human ureter during cystography suggests that the same phenomena may occur in man.

If this be the case, two phenomena may be invoked to explain the supravesical dilation that results from infravesical retention; *i.e.,* reflux for the more chronic cases and secretory dilatation for the more acute ones.

But the most interesting deduction from this theory is its bearing upon certain infectious phenomena, notably those of urethral chill, as detailed below.

RETENTION AND INFECTION

No chapter on urinary retention is complete without some observations on the subject of infection, for the following reasons:

Retention and the treatment of retention are the usual occasion for infection.

That an acute infection becomes chronic instead of getting well is almost always the result of retention, and conversely good drainage is the cure for urinary infection.

Spontaneous infection, presumably hematogenous and renal in origin, is the ultimate fate of the sufferer from chronic retention who escapes infection at the hands of his physician.

The anatomical changes resulting from infection are described elsewhere. The physiological changes may be considered, in one word, as fixative. By this we mean that while the evil effects of retention are relatively transitory and curable, the evil effects of infection are relatively permanent and fixed, and the more chronic the infection the more fixed are its permanent evil results.

One may thus grade the permanence of damage to function resulting from retention and infection as follows: The damage done by brief retention, however acute, disappears rapidly and spontaneously. The permanent damage left by a chronic retention increases in proportion to the duration of the retention. Acute infection, however brief, leaves permanent scar, temporary impairment

of function. Chronic infection fixes the impairment of function. You find a patient in acute retention below the bladder with a renal function of x and a bladder capacity of y. Relieve the retention and these will return to normal. Relieve an acute infection and the x and y will return almost to normal. To a less degree, if there be chronic retention without infection; to a less degree still, if the two combine.

The frequency of infection and the sources thereof demand a word here though the subjects are treated more at length elsewhere.

We must work upon the theory that the urinary tract above the compressor urethræ muscle is aseptic. Yet by the time one has reached adult life the urinary organs have certainly transmitted living bacteria from many a cold in the head and colitis, not to mention acne and other skin infections, while a deluge of urinary bacteria characterizes some of the graver infections. If there is retention of urine at any point in the urinary channels, chronic infection results. If not, the infection which must certainly result from the transmission of living bacteria by the kidneys usually passes unrecognized. The patient recovers and is apparently well. We think of his urinary organs as uninfected. But they are uninfected only in the same manner as a healed ulcer is uninfected. The disastrous infection that results from the reopening of war wounds has taught us that such wounds, even though seemingly soundly healed, may for months conceal living pathogenic bacteria. The same is true of the parenchyma of kidney and prostate.

Hugh Cabot once attacked the optimism of the pediatrician who discharges as cured the girl child that has been through an attack of acute pyelonephritis once the urine is grossly clear of pus and bacteria. On his demand a number were recalled and reëxamined. Half of them showed pathogenic bacteria on culture of the apparently normal urine, even months after dismissal from the clinic.

As much may be said of the prostate. Doubtless very few prostates are ever again free from bacteria after a gonorrhea or even after the familiar post-influenzal prostatitis, while the rule is almost universal that every male with pyelonephritis has prostatitis. The frequency of latent prostatitis is illustrated by the fact that the enthusiasts for prostatic massage have discovered that even though the first massage does not deliver pus and bacteria to the observation of the microscope, the trauma of a good brutal rubbing may be counted upon to produce a reaction sufficient to deliver them the next time the organ is massaged. Actually the urologist sees very few men with uninfected prostates.

Therefore whenever the urinary tract is invaded by instruments, it is to be recognized that infection may result not merely from bacteria that are introduced upon the instrument, but far more probably from bacteria that are already in the parenchyma of the prostate or kidney, awaiting only the trauma of a rough instrumentation or an overdistention in the course of pyelography to activate them.

Hence the need for an educated sense of touch. Jackstraws should reign

king of indoor sports for surgical interns, and were minnows not so greedy, fishing for them would educate the touch of the aspiring urologist. I took ten years to learn to pass a sound, just guiding it sufficiently to detect the different obstructions to its entrance into the bladder. I could have reached the desired gentleness sooner had I realized earlier that every outcry of the patient was my fault, every postinstrumental infection my doing. To look upon the chills and fever that so often follow the first dilatation of the ureter as cheering evidence that an infection has been located which we may now set about to cure, may be well enough, but it is also evidence that the ureter has been assailed with the touch of a gynecologist rather than that of the urologist.

DECOMPRESSION

The curative treatment of retention of urine is to remove the obstruction in urethra or ureter which impedes the outflow of urine. If it is impossible to relieve the retention and impracticable to permit it to continue, one may relieve the patient either by "derivation" of the urine, as the French call it, *i.e.*, establishing a communication between the outside of the body and some portion of the urinary tract above the obstruction, whereby the urine may be temporarily or permanently deflected, thus overcoming the evil influence of the back pressure; or if but one kidney is suffering, by nephrectomy.

Before undertaking to relieve retention, the urologist must understand the physiological effects of such relief. Retention of urine impairs the function of the kidneys and of the bladder, both temporarily and permanently, and if the back pressure is sufficiently slow to accumulate, a certain degree of compensation takes place whereby a considerable destruction of renal tissue may occur without sufficient depreciation of function to be very clearly shown by the blood chemistry, though the excretion tests will plainly show the lessened renal elasticity and lowered capacity to excrete solids.

When a chronic retention is relieved, the immediate effect of removal of the pressure is precisely the same as the visible result of removal of pressure from the outside of the body. The compressed blood-vessels dilate, the secreting cells of the kidney become acutely congested. As the result of this decompression the renal function is markedly impaired, perhaps so markedly as to cause complete decompensation and the death of a patient who, so long as he remained in an even balance of chronic retention, was apparently not particularly ill.

This phenomenon of grave or even fatal renal decompensation as the direct result of relief of chronic retention must be thoroughly appreciated before one can properly treat such types of chronic retention as those due to prostatism or to urethral or ureteral strictures.

The clinical phenomena of acute decompensation, due to sudden relief of chronic retention, are well known. There is intense polyuria, especially at night, with the accompanying mouth dryness, constipation, loss of weight,

fall of blood-pressure, and accumulation of nitrogenous products in the blood. If the case goes badly, the patient becomes delirious, he vomits all nourishment, he dies. In the most rapidly fatal cases the congestion of the kidneys is so intense as to produce anuria instead of polyuria and the patient promptly becomes delirious and dies in a few days.

The method by which we prevent the occurrence of these grave phenomena of decompensation is called decompression. It is to be employed as far as possible in the relief of chronic retentions whether with hypertension or not. It consists in the gradual reduction of pressure so that the kidneys which have become accustomed to working after a fashion under abnormally high back pressure may at least continue to work approximately as well with gradual lessening pressures until the normal is reached. This decompression should be applied in the treatment of all forms of chronic obstruction. Thus ureter strictures that have resulted in the so-called megalo-ureter should be dilated most homeopathically. Urethral strictures that have lasted for many years and gravely impaired the renal function should also be dilated in the very gentlest and slowest manner possible.

But decompression finds its daily application in the treatment of the chronic retention due to enlargement of the prostate. Certain rules for this treatment have been laid down by Von Zwalenburg,[3] by Bumpus and Foulds,[4] and by O'Conor.[5]

Their general conclusion is that decompression of the chronically distended bladder should be carried on over at least three to five days before the urine is permitted to flow out at normal pressures and that the evil effects of rapid decompression are most plainly indicated by vacillations of the blood-pressure while beneficial effects of correct slow decompression are readily interpreted from the steady blood-pressure, the good or evil effects of which are, of course, reflected in the blood chemistry.

It is, however, to be noted that these observers have gradually decompressed the bladder as though each unit of rise or fall in pressure was of the same importance to the bladder and to the kidneys above. This is obviously by no means the case. Any football player knows how a little air escaping from the ball will totally change the pressure within it. Bladder conditions are almost the same. Meredith Campbell, at my instigation, made some observations upon decompression, the summary of which follows:

Overdistention of the bladder is the retention of urine beyond the point at which the normal desire to urinate is felt.

This normal desire to urinate is felt by the normal bladder at about a pressure of 16 cm. water.

Withdrawal of 30 c.c. reduces the overdistention by at least 25 per cent.

Withdrawal of 50 c.c. reduces the overdistention by at least 50 per cent.

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[3] *J. Am. M. Ass.*, Dec. 18, 1920, lxxv, 1711-12.
[4] *J. Am. M. Ass.*, 1923, lxxxi, 821-23.
[5] *Arch. Surg.*, Sept., 1920, i, 359-67.

In our series, the overdistended bladder reached zero pressure with a residual urine of 90 c.c. to 720 c.c.

Interruption of decompression permits an immediate increase in bladder tension.

Decompression should be continuous.

The optimum rate of decompression has not been determined. We are satisfied to decompress completely within twenty-four hours although the blood-pressure is not always stabilized in this time.

The above statements summarize my practice during the past five years.

We know how enforced retention distends the bladder. In a similar manner too rapid decompression produces a condition within the bladder which simulates a minus-pressure. The congestion of the bladder wall is such that it bleeds and the bladder goes into a condition of acute congestion and spasm, quite comparable to that phenomenon which was known to our forebears as strangury and which consists in a grinding, constant ache of the bladder associated with very frequent and very painful urination and hematuria.

Now, even though decompression be slow—and the requirements of kidney decompression do not probably exceed twenty-four hours—the bladder capacity tends to decrease as decompression continues, even more rapidly than it increased under retention, so that for an even longer period than three to five days, it may be found that the attempt to discontinue bladder decompression results in bladder spasm, the beginning of strangury. This decompression strangury differs not at all from strangury that is encountered in cases of bladder tuberculosis, stone, tumor or ulcer, and where the bladder has never been overdistended. It is a spasm due to emptiness. Its treatment is the indwelling catheter whose external end is sufficiently elevated to prevent the bladder from ever being entirely empty and yet not sufficiently elevated to let the bladder ever be entirely full. This also is a type of decompression and may be considered as a physiological bladder, splint, an antispasmodic decompression.

The technic of decompression is described in Chapter XXV.

Complications of Decompression.—The usual complications of decompression are three: Epididymitis, renal infection and prostatic abscess.

In order to prevent epididymitis, it is the custom in many clinics to divide the two vasa and their surrounding lymphatics at the time urethral drainage is instituted. Epididymitis may follow this operation, perhaps because the operation has no prophylactic value, perhaps because the lymphatics are overlooked, yet the incidence of epididymitis after double vasotomy seems markedly lessened.

The epididymitis due to indwelling catheter is very likely to suppurate and should be drained without hesitation. One should also be on the lookout for central abscess of the testicle itself and for irregular toxic manifestations arising from either complication. One of my prostatics, upon whom vasotomy had not been performed, had abscess of both testicles as a complication to his prostatectomy. The febrile and local symptoms were not very striking but the patient

became progressively more delirious until an increase in tenderness and fever persuaded me to remove both testicles. The convalescence was slow and a considerable mental incoherence lasted for six months, since which time the patient has been perfectly well.

Acute suppuration in the kidney may be equally baffling in its symptoms and cause. The loin tenderness may be insignificant, indeed postmortem I once found that the fatal complication was an abscess in one closed-off calix. Toxic symptoms of a digestive or of a mental type may predominate. The diagnosis of the exact condition must be made without ureter catheterization. I have not performed nephrectomy or nephrotomy before prostatectomy but it must sometimes be necessary.

Prostatic abscess and abscess extending from the prostate upward under the trigone are among the more obscure complications of urethral drainage. The suppuration may not materially increase the size or the sensitiveness of the gland and the surgeon may well perform suprapubic drainage under the impression that the infection is in the kidney and not discover that it is in the prostate until after weeks of waiting for the symptoms to subside. He finally operates and falls into one or more abscess cavities in the prostate or under the trigone.

CHAPTER XII

THE UROLOGIC PHARMACOPEIA

The treatment of renal disease by the internist tends to become more and more defensive and physiological, rather than therapeutic. If there is nitrogen retention the nitrogen intake is limited; if there is salt retention the salt intake is limited. The practice of the urologist is far different. He too must assuredly determine nitrogen and salt retention and appropriately restrict nitrogen and salt intake. But these are almost minor interests to him, for however much their practice may overlap, essentially the internist is concerned with a chronic malady, the urologist with an acute one.

DILUTION

Only thus can one explain the wide divergence of practice in therapeutic dilution of the urine. The internist finds the urine quite dilute enough, is bothered, indeed, by the loss of power to concentrate. He recognizes that forcing fluids in order to make the kidneys secrete more urine is to call upon the kidneys for extra effort, to overstrain organs at the very moment we desire to spare them this effort. Let the urologist bear in mind these facts even while the acuteness of the renal crises he undertakes to combat forces him to give water with a lavish hand; and above all let the urologist recognize that his habitual extravagant administration of water to compensate acute impairment of the renal function has no place in the treatment of the chronically diseased kidney. The main therapeutic devices for the control of chronic renal disease are those of the internist, plus the special problems of relieving retention and providing antisepsis.

The urologist, then, once retention is overcome, attacks acute renal retention by the administration of large quantities of water, by mouth, by rectum, by hypodermoclysis, by infusion into the vein. His hope in emergencies, such as in overcoming the renal insufficiency resulting from prostatic retention, is to administer at least 4,000 c.c. a day. He thus washes the retained nitrogenous and other waste products through kidneys that could not otherwise transmit them. He employs the same methods, though less successfully, in washing out infection and in reducing the acute congestion of pyelonephritis.

The only conditions to the success of this dilution are three: (1) It must not be forgotten that urinary dilution has precisely the same effect upon drugs as upon any other of the urinary constituents. When caprokol, hexamethylenamin or sandalwood oil are administered the intake of fluids must be re-

stricted. Hence in many acute conditions, dilution being of the first importance, these drugs have no value. (2) Moreover, once the emergency has passed, the inflammation becomes chronic or controlled, dilution has done its work and should be discontinued. To continue it further is merely to put a useless strain upon the renal function and perhaps to keep up a bladder irritation that is ready to subside. (3) Finally, it is necessary to relieve the retention before supplying dilution. For the flood of diuresis may increase the retention, especially if it be prostatic.

URINARY ANTISEPTICS

By urinary antiseptics we understand drugs which, given by mouth or intravenously, have the effect of killing bacteria in the urinary channels and thereby preventing or diminishing inflammation therein.

Urinary antisepsis by intravenous medication is a hope of the future. Young's claims for mercurochrome have not been verified.

Two synthetic drugs are used by mouth: Hexamethylenetetramin and hexalresorcinol.

Hexamethylenetetramin (Hexamethylenamin, Urotropin, Formin, etc.).—The ammonium salt of formaldehyd has but one proven physiological effect. It liberates formalin in an acid solution, *i.e.*, in the stomach and in the urine.

The toxic effect of hexamethylenamin is felt in stomach, kidney and bladder as a result of the irritating properties of formalin. Some patients cannot take the drug in appreciable doses either because of the irritation to the stomach or because of the frequent and painful urination it excites or the hematuria which follows its administration.

The therapeutic effect desired of this drug is antisepsis of the urine and this antisepsis will vary in proportion to the concentration of the formalin in the urine which in turn will depend upon the acidity and the dilution of the urine and the amount of the drug administered. The formalin is liberated quite slowly so that Hinman and others doubt its therapeutic effect at the level of the kidney pelvis. The required theoretical concentration is 1:30,000. It is customary to give the drug in conjunction with acid sodium phosphate (aa 0.5 to 2 grams t.i.d.). Recently the efficiency of this acidifier has been denied and the present fashion is to administer ammonium chlorid in the same dose. It is believed that the hexamethylenamin is less irritating to the stomach if given about two hours after a meal, the acidifier before meals.

Some physicians employ hexamethylenamin for conditions that can only be aggravated by it, such as tuberculosis, elusive ulcer, urethritis, prostatitis. The drug has but two therapeutic uses, viz.: (1) for the prophylaxis and cure of acute infections, (2) for the control of chronic infections.

As a prophylactic, the drug is useful to prevent so-called urethral chill following a passage of sound or cystoscope. It has never been shown that its use immediately before or after operations is justified.

It is specific for the control of beginning pyelitis and it is entirely without

value for the treatment of established or chronic pyelitis. Therefore it is the ideal remedy for pyelitis of pregnancy when diagnosed early on the appearance of bacteria, albumin and pus in the urine and within the first few days after the temperature has risen.

It is of no value in the treatment of pyelitis of children because this is not diagnosed early enough.

The only chronic conditions that are benefited by hexamethylenamin are those in which the infection is mild, the irritation inconsiderable, the retention of urine constant and great. This is the ideal antiseptic for tabetic patients depending upon a catheter to empty a paralyzed bladder. Some of my patients have gone for years catheterizing themselves, using no other antiseptic than this and yet usually presenting a urine that was either absolutely clear to the eye or only the least bit turbid with pus. But patients with enlarged prostates do not usually derive much benefit from it and patients who empty their bladder frequently because of inflammatory conditions may only expect to be irritated.

Hexalresorcinol (caprokol).—This antiseptic works on a different principle. It does not require acidity of the urine but concentration, for it derives at least part of its antiseptic effect from its power to reduce the surface tension of the urine. This surface tension is increased by dilution and by the administration of sodium bicarbonate, but is not influenced by alkalinity in general. Hence, hexalresorcinol is of considerable value only on condition that the urine is concentrated. The drug must be given in doses of 0.2 to 0.6 grams, t.i.d. It is administered in capsules or in emulsion. It irritates the stomach and to a less degree the bladder much as hexamethylenamin does.

It was introduced with high hopes and vigorous claims of urinary antisepsis. These hopes have not been realized. I have cured with it one case, a rebellious but mild pyelitis due to hemolytic streptococcus. I have failed to control with it a mild pyelitis, occurring in the slightly dilated pelvis of a perfectly healthy middle-aged man, although he took the drug both alone and in combination with hexamethylenamin for one year.

Caprokol is of course without value in the treatment of such chronic cases as have grave impairment of the concentrating function of the kidney, for their urine is always dilute. It is even a dangerous drug to use at the time of operation, for in several instances I have noticed that the restriction of fluid actually threatened the patient's life.

Yet caprokol has its unique good qualities. It is the one urinary antiseptic which attacks the urea splitting cocci. Although it will by no means sterilize the urine of these patients, it should always be administered, even when urinary concentration cannot be obtained, if the urine is foul or if there are incrusted ulcers of the bladder or of the suprapubic wound after operation. It may be used locally in conjunction with mercurochrome.

The Empiric Remedies.—In considering the systemic effect of drugs upon inflammations of the urinary channels, one must take into consideration not only the antiseptics but the sedatives. Two antiseptics have been mentioned.

I have tried many others. I feel confident that mercurochrome, pyridium, acriflavin and methylene-blue by mouth have no value beyond the impression they make upon the patient's mind. If they did not color the patient's urine, they would not color his thoughts. If salol, the benzoates, the borates, etc., have any antiseptic value, it is so slight as to be negligible.

But the balsamics enter into this category. Unquestionably they do something to the urine which renders it relatively soothing. Like caprokol, they have little value if diluted but if the patient with an inflamed and irritated bladder has sound kidneys, many of the balsamics will soothe the irritation and thereby distinctly help control the infection whether it be due to gonococcus, tubercle bacillus or other bacteria. Each old practitioner has his favorite balsamic preparation. It is impossible to judge between them. I fancy the sandalwood oil preparations. The pure oil in capsules and in doses of 0.5 to 1 gram, t.i.d., seems as efficacious as any of the others. I have not been able to appreciate the virtue of any of the synthetic balsamics. It is not to be forgotten that sandalwood oil in overdose not only disturbs the digestion but also occasions severe backache, which may be attributed to renal congestion.

Alkalinization.—Alkalies have long been employed to reduce the acidity of the urine and thus lessen the symptoms of acute gonorrhea at its height. The aim is to keep the urine as nearly neutral as possible. Excessive alkalinity is as objectionable as excessive acidity. Any alkali may be employed. Sodium bicarbonate, 1 to 2 grams, t.i.d., is the usual prescription, controlled by frequent urinalysis. The wealthy enjoy Vichy Celestin in place of the forbidden ginger ale. An ancient popular soothing prescription is:

℞. Liq. pot. . . . . ℥ij-vj (8.00-25.00 gms.)
Tr. hyosc. . . . . ℥ss-j (15.00-35.00 gms.)
Aq. cinnam. . . . . q.s.ad. ℥iij (100.00 gms.)

M.
Sig. Teaspoonful in water three or four times a day.

Acidification.—Both alkalinization and acidification of the urine are employed for the mere purpose of changing the reaction of that fluid and thereby rendering it a less happy medium for the growth of bacteria that are flourishing in it. Thus mere alkalinization may markedly improve an acute pyelonephritis and acidification is often necessary to make the urine sufficiently acid to disengage formalin in antiseptic concentration from hexamethylenamin.

The best means of inducing either acidity or alkalinity of the urine should be diet. It is claimed that meat, eggs and grain products are notable acidifiers, while other vegetables, notably the roots, are alkalinizers.

Many drugs, such as benzoates and the acid sodium phosphate, have been used for the purpose of rendering the urine acid. The favored drug at present is ammonium chlorid which, in doses of from 0.5 to 2 grams t.i.d., is more efficacious than the others.

Local Urinary Antiseptics

I shall attempt a discussion of only those chemicals with which I am familiar.

Silver Nitrate.—Silver nitrate is used in all the specialties that have to do with mucous membranes. The laryngologist finds it as preëminently useful as does the urologist. Rarely a patient is so sensitive that it cannot be employed, but such exceptions are few and, apart from these, silver nitrate is the most generally useful antiseptic for applications to the kidney pelvis, in strength up to 1 per cent, to the bladder, in strength between 1 :1,000 and 1 :20,000, and the posterior urethra, instillations from 1 :20,000 to 2 per cent, urethroscopic applications, from 10 per cent to 50 per cent. Silver nitrate has not been used successfully in the anterior urethra.

Its value, like that of most of the older antiseptics, is apparently due rather more to its astringent effect than to its actual destruction of bacteria. Silver nitrate heals a sore spot whether it be an exuberant granulation upon the skin or in the posterior urethra, whether it be a pyelitis or a cystitis.

Potassium Permanganate.—This has the same properties as silver nitrate but in the strength used it is less cauterizing, less astringent, less antiseptic. It is commonly used in large quantities of dilute solution, from 1 : 6,000 to 1 : 3,000, for the irrigation of anterior and posterior urethra and bladder. In the treatment of acute anterior urethritis due to any bacteria, it used to be the first choice and following the lead of Janet, the French still depend upon it largely for the control of acute gonorrheal or simple urethritis. In the United States it is less and less used for this treatment, because in the hands of most men it controls the acute manifestations very nicely, but does not usually shorten the duration of the disease. Indeed, dependence upon it seems rather to lengthen the course of chronic urethritis.

But one is often chiefly concerned to wash out the urethra or the bladder merely for the purpose of getting rid of the accumulated pus and for a mildly astringent effect. Potassium permanganate is preëminently qualified for this purpose especially as there are still many practitioners to agree with Van Buren, who maintained that no gentleman could be expected to use silver nitrate. In the strength employed the solution is rather astringent than antiseptic.

Boric Acid.—This is the ideal solution to place in the hands of a careless and ignorant patient for autolavage. The patient is given a pound of crystals with the knowledge that no solution he can make from this will be so strong as to do him any harm. The solution is of the same quality as potassium permanganate, but even less astringent and less antiseptic.

Protargol.—This is the most generally used of the albuminates of silver. Solution should be made up fresh, the drug being kept in the form of powders. If mixed with hot water the tendency to make a gummy, relatively insoluble substance, adherent to the stirring rod is lessened. Protargol is much used in 1 :200 strength as a prophylactic injection for gonorrhea. In the repressive

treatment of acute anterior urethritis, injections two or three times a day of 1:400 solution are employed.

This and the following drugs are all relatively non-astringent, more or less penetrating to the mucosa, as compared to the drugs described above which do not penetrate at all, and of relatively high laboratory bactericidal property. Only those drugs are listed which I know to be practically efficient.

Albargin.—This has much the same properties as protargol and is used in about half the strength. Both albargin and protargol are somewhat more irritating than the next two to be described.

Argyrol.—It is said that most bacteria will grow in an argyrol solution, yet it is a widely used antiseptic chiefly because of its mildness. Crystals of argyrol are excellent applications for chancroids. In the treatment of acute urethritis solutions should be freshly made every alternate day and employed in strength of 10 per cent three or four times a day.

In the same strength it may be used as a soothing injection for very irritated bladders, though exceptionally such concentration will prove irritating instead of soothing. It has helped me control incrusted ulcers when mercurochrome is too irritating.

Neosilvol.—This has much the same properties as argyrol, is used in the same strength and being white instead of black is preferred by many.

Acriflavin.—This dye is now made under the name of neutral acriflavin and is relatively free from the hydrochloric acid which caused strictures of the urethra without exciting pain when the older preparation was used in strength of 1:1,000. But even the neutral acriflavin has a slight tendency to irritate tissue without irritating nerves, *i.e.*, to cause ulcers without exciting pain so that it should not be used too frequently or in too great strength. In the bladder and for occasional use in the urethra, 1:1,000 freshly made solution may be employed. For the repression of acute gonorrhea, 1:4,000 twice a day is strong enough and frequent enough.

I have almost entirely replaced the irritating nitrate of silver by the non-irritating acriflavin for all prophylactic work, such as the irrigation of the urethra and bladder to prevent infection by the passage of instruments. It is also an admirable drug for the control of acute gonorrhea and of mild infections of various sorts. It is quite penetrating, non-irritating and apparently of no great value if the infection is severe. It acts much like argyrol. I have had the habit of filling wounds with it in order to prevent infection when the wound was soiled by the contents of bladder or kidney.

Mercurochrome.—Mercurochrome intravenously has apparently shot its bolt. The uncertainty of its action, the lack of any scientific foundation for its use, the deaths that it has caused by acute mercurial poisoning, have condemned it.

As a local urinary antiseptic, however, it has great value. It penetrates the mucosa, it kills Gram-positive organisms very effectively. Combined with caprokol internally it seems the best remedy we have against incrusted lesions. It is

an admirable wound dressing after bladder or kidney operations, though fear of mercurial poisoning deters us from using it in the wound at the time of operation.

Its disadvantages are that it is not useful in the treatment of gonorrhea, except about the cervix uteri, and it is so exceedingly irritating to some persons that they cannot bear it.

For instillation into an irritated bladder, one begins with a few drops of 1:200 solution. From this the strength may be increased to 2 per cent and even higher.

The Zinc Salts.—The best injection for a patient to use in his own urethra in order to control the discharge from a subsiding or a chronic gonorrhea is an astringent one. This does not cure the disease. The cure must progress spontaneously or as the result of the mechanical treatment, but the astringent keeps the patient clean. For this purpose the zinc salts are the best. Authors of the past generation who depended largely upon astringents through lack of understanding in the management of the infection, gave many and varied formulæ. Doubtless a 1:200 solution of zinc sulphate is as effective as any of them. I usually employ a modification of the old Brou injection (2 per cent zinc sulphate in dilute lead water). The result of the mixture is an insoluble lead sulphate in a solution of zinc acetate. The patient is instructed to shake the mixture and it is believed that the adhesion of the lead sulphate powder to the wall of the urethra helps by capillary action to keep the zinc acetate solution in contact with it. The formula is the following:

℞ Zinc. sulph. .....gr. xii (1 gm.)
Liq. plumb. subacet. dil. .....℥ vi (200 c.c.)

M.
Sig. Shake. Inject twice a day.

CHAPTER XIII

ETIOLOGY OF INFECTION OF THE UPPER URINARY TRACT

The upper urinary tract consists of the kidneys and their ureters, the bladder, and the posterior urethra. The cut-off muscle separates the upper from the lower tract. The former is inside the body, as it were, and in its normal state entirely aseptic. The lower urinary tract—*i.e.*, the anterior urethra of the male, the whole urethra of the female—is in no way separated from the integument, and may contain the bacteria that flourish upon the surrounding parts.

Bacteria Found in Healthy Anterior Urethra.[1]—Pfeiffer examined twenty-four urethræ and found diphtheroid bacilli in twenty-one, streptobacillus in ten, *Staphylococcus pyogenes aureus* in five, *Micrococcus candicans* in four, *Sarcina alba* in fourteen. Petit and Wassermann found five kinds of cocci, six kinds of bacilli. Franz, in fifty-six urethræ, found the sarcina once, the *Bacillus coli* once, pyogenic staphylococci six times, streptococci twice and seven other varieties of cocci and four varieties of diplococci.

These bacteria are usually found at or near the meatus. The deeper portion of the anterior urethra is often sterile.

Bacteria of Chronic Anterior Urethritis.—Of 154 cases[2] examined twenty were sterile, ten showed gonococci alone, ten gonococci mixed with other bacteria, 114 other bacteria without gonococci.

Of von Hoffmann's cases, the gonococcus apart, eighteen showed pseudo-diphtheria bacillus, twelve *Streptobacillus urethræ,* two *Bacillus subtilis,* three *Sarcina alba,* one *Proteus vulgaris,* one *Bacillus coli,* one Friedländer's bacillus. He also found twenty-seven kinds of staphylococci, three other cocci, and six kinds of bacilli.

Bacteria of Chronic Prostatitis.—Young, Geraghty, and Stevens,[3] examined nineteen cases (two non-gonorrheal) and obtained a growth on agar in only eight. The *Staphylococcus albus* was identified thrice, the *Streptococcus pyogenes* twice. The anterior urethra was copiously irrigated and the prostatic secretion obtained through a sterile urethroscopic tube. Control cultures were made from the bulbous urethra.

Notthaft, using less careful methods, examined 120 cases. He found the gonococcus alone in five cases, all within eighteen months of the time of infection; the gonococcus alone or with other bacteria in 60 per cent cases of less than eighteen months' duration, in 18 per cent cases of from eighteen to twenty-four months' duration, in 6 per cent cases of from twenty-four to thirty-six

[1] Von Hoffmann, *Centralbl. f. Harn u. Sex. Org.,* 1904, xv, 569.
[2] Reported by Tano, Cohn, Owens and Von Hoffmann.
[3] *Johns Hopkins Hosp. Rep.,* 1906, xiii, 276.

months' duration. The gonococcus was not found after the third year. The gonococcus was found forty-seven times, other micrococci 119 times, bacilli were found fifteen times, other bacteria fourteen times.

In as much as the upper urinary tract is aseptic when in its normal condition, the three prime questions to be answered in regard to the etiology of inflammations are:

1. What are the bacteria of urinary infection?
2. How do they obtain access to the urinary tract?
3. Why do these bacteria sometimes cause infection, and sometimes not?

BACTERIA OF URINARY INFECTION

Since the gonococcus, the typhoid bacillus, and the tubercle bacillus have, for obvious reasons, no statistical relation to the other bacteria causing infection of the urinary organs, and since they cause types of infection which are best considered separately, they are not included in the following data.

A study of the bacteria found in the infected urinary organs has been made by David.[4] The cultures were obtained from cases of infection of various parts of the urinary tract.

Aërobes—

23 Bacillus coli
15 Staphylococcus albus
3 Staphylococcus aureus
5 Bacillus enteritidis
3 Bacillus fæcalis alkaligenes
2 Bacillus proteus
2 Bacillus pyocyaneus
1 streptococcus
1 Bacillus pseudodiphtheriæ
1 unidentified Gram-positive diplococcus
1 pneumococcus
1 influenza-like bacillus

Anaërobes—

4 black-pigment-producing bacilli
4 Gram-negative, influenza-like bacilli
2 Staphylococcus parvulus
1 Gram-negative coccus
1 Bacillus funduliformis
2 Gram-positive staphylococcus

[4] *Surg., Gynec. & Obst.*, April, 1914, xviii, 432.

Young [5] has tabulated a series of 356 cases of urinary infections as follows:

	Cases	Pure		Mixed	
		Number	Per Cent	Number	Per Cent
Gram-negative bacilli	192	128	66	64	33
Gram-positive cocci	227	115	50	112	50
Gonococci	14	7	50	7	50
Other gram-negative cocci	2	0	0	2	100
Proteus	7	2	..	5	...
B. pyocyaneus	16	2	..	14	...
Actinomyces	3	0	..	3	...
Diphtheroid	2	1	..	1	...
Yeast	1	1	..	1	...

The relation of the anaërobic bacteria to infection has not yet been determined. We shall consider only the aërobes.

It is to be noted that various bacteria may grow simultaneously in the urinary tract. The *Bacillus coli* is usually a part of such mixed infections. It is further to be noted that certain of the bacteria separately listed in the above table may be grouped. Among the fifty-eight listed aërobes, bacteria of the colon group appear thirty-one times (53 per cent), staphylococci eighteen times (31 per cent), while the remaining bacteria may be classed as infrequent.

Scheidemantel [6] examined one hundred cases with the following results: eighty-nine colon group, six staphylococci, three proteus, two streptococcus, two influenza bacillus, and typhoid bacillus, a diplococcus, and the pyocyaneus, each once.

This represents quite closely the bacteria found in infections of the renal pelvis, while David's list represents more accurately those of infections of the bladder and prostate. In other words, *infections of the renal pelvis result almost always from bacteria of the colon group, while infections of the bladder are much more frequently due to the pyogenic cocci.*

On the other hand, every writer who has reported bacteriologic investigation on perinephritis has noted the preponderance of the pyogenic cocci in the pus obtained from perinephritic abscess. Though the number of cases reported by any one observer is small, the universal agreement on the preponderance of *staphylococci and streptococci* in causing *perinephritic suppuration* is notable.

Virulence.—The available data do not suggest any particular virulence attributable to any specific bacteria or strain of bacteria. It would seem as though the virulence of bacteria depended most upon the accessory circumstances under which the infection occurs.

Indeed experiments upon animals have amply proven two facts: In the first place, bacteria may be presented to the kidney in the circulating blood, pass

[5] *Practice of Urology*, Vol. I, p. 96.
[6] *München. med. Wchnschr.*, 1913, p. 1722.

through it and be found living in the urine, and yet leave no gross trace of their passage. In the second place, bacteria may be injected into any portion of the normal urinary tract, and cause no damage whatsoever. Clinical observations have confirmed these findings. Thus we may say that the occurrence of infection usually depends upon the simultaneous presence of bacteria and some accessory cause of infection.

On the other hand, one of the causes of intense infection is the bacterial splitting up of urea into ammonia and water. The ammonia is an irritant, and causes a much more severe infection, ammoniacal infection, than occurs when the urine remains acid. The chief urea-splitting microbes are the proteus, the pyogenic cocci, and sometimes the typhoid bacillus. These various bacteria show a marked difference in their tendency to split urea. Sometimes they do so, sometimes they do not. The accessory causes of infection have a marked influence in encouraging urea splitting. The colon group of bacteria, with an occasional exception of typhoid bacteria, do not split urea. A marked colon infection gives to the urine the odor of a dead mouse, but does not produce ammonia.

Crabtree believes that acute hematogenous kidney infection due to *Bacillus coli* is a transitory lesion that merely lays the foundation for chronic pyelitis; while grave suppurating parenchymatous lesions are always due to the pyogenic cocci.

The more virulent pyogenic cocci, on the other hand, are sometimes presented to the kidney in such numbers, probably in the form of an actual embolus, from a furuncle or other coccic skin lesion as to cause a lesion of the parenchyma, usually single, too grave to be overcome by any local immunity. Such lesions are spoken of as carbuncle of the kidney and result in perinephritic abscess. They occur in perfectly normal kidneys and require no predisposing lesion of the urinary organs.

The normal prostate may also become inflamed as a result of overdose of circulating bacteria, notably from infection of the tonsils and upper air passages. The resulting lesion is a diffuse infection of the gland that rarely results in abscess.

Rosenow has raised the question of a specific organotropism characteristic of certain bacteria. He produced pyelonephritis in animals by injecting into the circulation bacteria obtained from human pyelonephritis. Meisser, his coworker, and Bumpus isolated a streptococcus that excites submucous cystitis, and Hinman confirmed this. He even occasioned stone formation in the kidneys of dogs by injecting into their gums streptococci obtained from the urine of patients with urinary calculi.

Hunner strongly advocates the theory that stricture of the ureter and submucous cystitis are often metastatic lesions from teeth or tonsils.

Yet the specific organotropism on the part of special bacteria has not been fully proven. The validity of Rosenow's conclusions has been questioned, and while one may accept readily enough the general thesis that metastatic infection

of the urinary organs does occur, it is not clear in how far the predisposing local lesion or the specific organotropism of the microörganism predominate.

ROUTES OF INVASION

Bacteria reach the urinary tract through four routes:

1. The descending or excretory route
2. The ascending or urethral route
3. The lymphatic route
4. Direct invasion by trauma or rupture of a neighboring abscess

The Descending or Excretory Route.—Without stopping to debate the question whether or not the healthy kidney can transmit living bacteria in any number without injury to its secreting structure, we may accept as clinically proven, notably in the case of the typhoid bacillus, the fact that *living bacteria may enter the urine from a kidney clinically sound.* There is strong evidence for the belief that in the course of the various infectious diseases, even in tuberculosis, bacteria may be transmitted by the kidneys without leaving any appreciable trace of their passage through those organs.

In as much as it seems biologically impossible for the living cell to transmit a living bacterium, it is probable that normal kidneys transmitting healthy, living bacteria, actually suffer a temporary localized inflammation so slight as to escape observation. Crabtree's [7] observations certainly seem to justify the theory that acute descending *B. coli* infection of the kidney, sufficiently intense to cause symptoms and to produce a marked temporary diminution of phenolsulphonephthalein output, may disappear so completely that a few weeks later the pathologist is unable to identify any lesions in the kidney.

Such acute temporary infections may perhaps occur in otherwise normal kidneys damaged only by the effort to excrete a large number of bacteria, while congested by the toxins of these very bacteria circulating in the blood. Such a combination would explain, for instance, the fact that about one case in four of typhoid fever suffers mild renal infection. Yet no relation has been established between the severity of the infectious disease, or of its toxemia, and the likelihood of renal infection resulting therefrom. Hence we cannot but ask ourselves whether even in these cases the one infected case out of four is not perhaps infected because of some local cause of lessened resistance in the kidney.

On the other hand, we must admit that colon infections at least are almost always bilateral. For the acute type of infection we can usually find a mechanical accessory cause. But for the milder infection of the opposite kidney we usually find no such cause. It is probable, therefore, that toxemia and massive doses of bacteria in the blood are the occasion of this opposite infection.

In order to explain the fact that pyogenic cocci are relatively common in perinephritic abscess, and colon bacilli relatively common in infections within

[7] *Cf.* Cabot, *Tr. Am. Ass. Genito-Urin. Surg.*, 1916.

the cavity of the kidney, Crabtree has evolved the ingenious theory that the pyogenic cocci exhibit in the kidney, as they do elsewhere in the body, a relative tendency to immediate pus production of considerable intensity as compared to that of the colon group. Reaching the kidney through the circulation, the pyogenic cocci set up their infection in the glomeruli, *i.e.*, in the cortical portions of the kidney; whereas the colon bacilli are more likely to pass through the glomeruli, and to attack the tubules. Hence colon bacillus infection extends more readily to the pelvis of the kidney, coccus infection to the perinephritic tissue.

The sources of excretory renal infection are innumerable. The bacteria may be derived from focal infection in various parts of the body, or catarrhal infections of the various mucous membranes. The intestine is the usual source of *Bacillus coli* infection, but the other bacteria are derived from roots of teeth, tonsils, adenoids, furuncles, accessory nasal sinuses, appendicitis, salpingitis, prostatitis, etc.

In the following section reasons will be given for suspecting that the bladder, the prostate, and the vagina are not uncommon sources of descending infection in clinical conditions that have heretofore been considered instances of ascending infection.

Urethral or Ascending Invasion of the Bladder.—The three methods by which microbes may ascend from the urethra to the bladder are:

1. Through instrumentation
2. By extension upward of a urethral inflammation
3. By spontaneous ascension of the urethral bacteria

1. The passage of an instrument into a clean bladder is a frequent cause of cystitis. The gentle passage of a smooth, soft, clean instrument through a normal canal into a healthy bladder never causes cystitis. Perhaps pathogenic bacteria are introduced in this manner. But experiment and experience unite to proclaim that the healthy bladder is thoroughly able to sweep itself clean of these enemies. But this is not enough. The bladder may be thus protected, but not so the posterior urethra. Not to mention the gonococcus, any of the bacteria enumerated above can take root in the prostatic portion of the canal, if only the soil is sufficiently harrowed to receive the seed.

In as much as every passage of an instrument into the posterior urethra contuses that canal, at least to a slight degree, it is impossible to reproduce clinically the laboratory condition under which bacteria may be safely introduced into the bladder. Ascending infection of the urinary tract, like descending infection, requires a contributory cause as well as a bacterium. But clinically the contributory cause is ever present. No passage of a urethral instrument is entirely free from trauma. No prostate is guaranteed free from a preëxisting, unsuspected latent infection. It is, therefore, the surgeon's first duty to see to it that his passage of urethral instruments be as cleanly as possible; his second duty, as important as the first, that the instrumentation be as gentle as possible.

But in as much as the normal anterior urethra cannot be made wholly aseptic, while the bladder into which the urethral instrument passes, and the prostate over which it passes, are often already diseased and contain in themselves the contributory causes of infection and even, in the case of the chronically inflamed prostate, the bacteria themselves, it is obvious that no amount of cleanliness or of gentleness will protect the bladder against infection when instruments have repeatedly to be passed, as, for instance, in the treatment of prostatic retention.

2. Infection of the bladder by direct extension of urethritis occurs in gonorrhea, and in stricture; also from the prostate in cases of prostatic retention. Direct extension of urethritis to the trigone is as common in women as in men.

3. Whether the bacteria of the uninflamed anterior urethra can ascend to the bladder against the urinary stream is not yet definitely determined.

Ascending Infection of the Kidney.—Innumerable experiments have repeatedly proven that bacteria do not ascend from the bladder to the kidney in animals unless there is some accessory cause of infection. This accessory cause, both in experiments and in the human being, is usually some form of retention of urine.

The routes by which infection may conceivably reach the kidney from the bladder are three:

1. Up the lumen of the ureter.

2. Through the lymphatics extending along the ureter from the bladder to the kidney pelvis.

3. By lymphatic absorption from the bladder or prostate into the general circulation, and thence, by what is actually a descending infection, into the kidney parenchyma.

Evidence has been accumulating for years to disprove the theory that infection can travel along the inside of the ureter from bladder to kidney. This evidence has been summed up in the observations of Sweet and Stuart.[8] They have reviewed the evidence of the existence of a network of lymph-vessels in the mucosa, and submucosa, as well as in the external coats of the bladder and ureters and in the pelvis of the kidney, and have shown that this network anastomoses freely throughout. In their experiments they have traced infection up these lymphatics, and have shown, by replacing a section of the ureter with a tube that maintains the lumen of the canal, but interrupts the lymphatic flow, that under appropriate circumstances bacteria will travel up to the opposite kidney whose lymphatics are intact, but not up to the kidney whose ureter has been divided; although the trauma of ureteral division should, in itself, lower the resistance of that ureter.

How frequently such lymphatic infections of the kidney occur remains an open question. The familiar acute, so-called ascending infection, such as is seen in postoperative infection, in prostatic retention infections, in urethral chill, and

[8] *Surg. Gynec. & Obst., April,* 1914, xviii, 460.

in defloration pyelitis, has been shown in several instances to be associated with a general bacteriemia, while postmortem examination fails to show any evidence of ascending lymphatic infection along the ureter.

Crabtree cites a case in point: The patient entered the hospital for the treatment of a prostatic retention of urine. A catheter was tied in the urethra, and repeated cultures made from the urine obtained through this catheter failed to show any bacterial growth. On the seventh day the patient complained of some uneasiness in the perineum. A blood culture was promptly made, revealing colon bacillemia. Meanwhile the urine still remained sterile. Then the patient had a chill, fever, pain in the loin, and a sharp fall in the output of phenolsulphonephthalein. Blood culture was now negative, but culture of the urine showed *Bacillus coli.* In due course the phenolsulphonephthalein output returned to normal, the patient submitted to perineal prostatectomy, and two weeks thereafter died of streptococcus septicemia. Postmortem examination revealed no gross evidence of renal infection, or of lymphatic infection about the kidney pelvis and ureter.

Such cases force us to the conclusion that the acute phenomena of kidney infection under the clinical circumstances enumerated above, although they have always been spoken of as ascending infections, may actually be descending infections from a source in the lower urinary organs, or in the vagina in the case of defloration pyelitis.

Thus the absence of any positive evidence of spontaneous infection of the normal bladder from the normal urethra, or of the kidney from the bladder, leaves the theory of spontaneous ascending infection "from the short urethra" of women without support. If this does occur, we have no theory whereby it can be explained, unless, in the case of renal infection, it occurs by ureteral reflux.

Direct Lymphatic Invasion.—The possibility of direct lymphatic infection up the ureter has been shown by Sweet and Stuart. The possibility of direct infection of the right kidney from its lymphatic communication with the hepatic flexure of the colon has been shown by Franke.[9] It is also possible that the bladder may be directly infected by lymphatic invasion from the rectum or the vagina. Finally, any portion of the urinary tract may be directly infected by lymphatic absorption from an adjacent focus of suppuration.

But the actual frequency of infection along any of these routes is by no means certain. Future investigators will have to determine their clinical importance.

Infection by Irruption and Trauma.—The mechanism by which infection reaches the urinary channels from the rupture of an abscess into them, or by trauma directly introducing bacteria, requires no special explanation. But it is not to be forgotten that if the urinary passages are otherwise normal even the discharge into them of pus from a suppurating appendix, an intestinal fistula or a pyosalpinx produces only a localized infection.

[9] *Grenzgeb. d. Med. u. Chir.*, 1911, xxii, 623.

THE ACCESSORY CAUSES OF INFECTION OF THE URINARY ORGANS

The mere passage of pus and bacteria through a normal bladder discharging from an infected kidney does not cause cystitis. The mere presence of infection in the bladder, without retention of urine, does not cause infection of the kidney. The mere presence of bacteria in the blood does not cause infection of the kidney. Indeed, when the kidney becomes infected in the course of a pyemia, the characteristic result is the bilateral pyemic kidney, very different from anything we have to deal with in surgery.

The laboratory suggests the explanation. It has been shown again and again by various experimenters that the normal kidney and the normal bladder are not harmed by the injection into their cavities of enormous quantities of pathogenic bacteria; while intravenous injection of bacteria either causes the bilateral pyemic kidney or apparently does no harm. But if the urethra is tied off, both bladder and kidneys may be readily infected. If one ureter is tied off, or one kidney traumatized, injection of the bacteria into the circulating blood results in infection of that kidney. Manifestly, therefore, we may look for the cause of infection of the urinary organs in some accessory condition that renders the organ in question peculiarly liable to infection. Such a condition we speak of as the *accessory cause of infection.*

We should consider these accessory causes of infection in the light of recognized clinical conditions. Some of these clinical conditions are readily explained, *e.g.,* infection due to retention, stone, or trauma. Some are not so easily explained, *e.g.,* the pyelonephritis of little girls. Perhaps the best test of any general theory of the accessory cause of infection in obscure cases is that it should explain why the right kidney is more often acutely infected than the left, why the kidneys of women are more often infected than those of men, why women are so commonly infected in their infancy. In other words, the theory must explain the infection of the right kidney of little girls.

The accessory causes of renal infection include any condition, whether mechanical or toxic, that reduces the resistance of one or both kidneys to infection. They may be classified as follows:

1. Retention
   - (*a*) Urethral
   - (*b*) Ureteral
2. Trauma
3. Toxic influences
4. Reflex influences

Retention.—Retention of urine, whether acute or chronic, causes congestion of all that portion of the urinary tract lying above the point of retention. Thus if the retention is in the urethra, both kidneys and the bladder are involved. If it is in one ureter only, one kidney is involved. The congestion is due to actual

pressure of urine. Any one who has seen a patient writhing in the agonies of acute retention of urine will not doubt its existence in acute cases. The congestion of the kidneys in chronic retention is shown by the reduction in the output of solids, notably of phenolsulphonephthalein. It is also shown by an acute congestion at the time of relief of renal retention, signalized by a marked polyuria. Albarran was the first to note that the evacuation of an intermittent hydronephrosis was followed by a period of polyuria from that kidney. A similar polyuria is a feature of grave prostatic retention. But even the slightest obstruction is quite capable of disturbing the normal function of bladder and kidneys. Thus very slight obstructions at the bladder neck may cause retention of urine, stone formation, and infection. Similar slight and unsuspected obstructions of the ureter may cause congestions of the kidney, which, though they may be but slight or temporary, may happen at a time when the presence of bacteria in the blood offers the occasion for renal infection. Crabtree's case cited above is a very good example of how temporary even an acute infection of the kidneys may be.

If we are to find in the theory of retention a cause for the infection of the right kidneys of little girls, we must seek it in some congenital condition. Let it be understood that the following theory is but a theory. Although it seems at the present moment the most likely explanation of obscure infection of the kidney, it is no more than this.

Renal mobility is discussed in Chapter XXXII. Therein will be found an exposition of the theory of Volkow and Delitzen, which pretends to explain by a study of the anatomical shape of the niche in which the kidney lies why this niche, being shallower in women than in men, and on the right side rather than on the left, makes the right kidneys of women more liable to mobility, as, indeed, we clinically know they are, than their left kidneys or than either kidney of a man. It is to be noted further that in many instances the position of the body determines whether the kidney shall be mobile or not, and that children may be trained to hold themselves in such a way that their kidneys shall not become mobile when they reach adult life. Thus, although what might be termed the gross mobility of the kidney occurs in adolescence and thereafter, the beginnings of this mobility are congenital.

Now it is well known that the grossly mobile kidney encourages inflammation, and does so by virtue of kinking of the ureter whereby a moderate or temporary retention occurs in the kidney which may, under exceptional instances, reach an intensity shown by the retention of intermittent hydronephrosis.

The same conditions exist to a lesser degree in little children. But it is to be remembered that little children are much more subject to infections of all sorts than adults. Their immunities are undeveloped by contact with infection. Doubtless their kidneys share this lack of immunity, and doubtless, therefore, the kidneys of infants are more readily infected than those of adults. This combination of unusual susceptibility to infection, and tendency to mo-

bility, explains, we believe, the infection of the kidney in children, and more particularly the infection of the right kidney in little girls.

The only other theory that has been seriously advanced to explain this condition is that the vagina of little girls is often infected with colon bacilli from the rectum, that the urethra of little girls is short, that they often have incontinence of urine, and that under these conditions the *Bacillus coli* readily invades the bladder, and then the kidneys. But all our experimental evidence points to the fact that no infection can result from the invasion, either of the bladder or of the kidneys, by colon bacilli unless there are accessory causes of infection at work. Renal mobility is the most plausible accessory cause. Whether in the presence of renal mobility, a short urethra, or an infected vagina, or incontinence of urine helps to infect the kidney we do not know. It seems rather more probable that the infection is usually derived from an inflamed colon.

A third theory of infection which would infect the right kidney directly from the lymphatic connection with the hepatic flexure of the colon would be difficult either to prove or to disprove. But since it does not explain the frequency of this condition in little girls, we may neglect it.

Most acute infections can be considered in terms of retention. Even stone and tumor often excite infection as much as foreign bodies that obstruct the outflow of urine than as much as a breeding ground for bacteria, or a source of surface irritation.

Ureteral obstruction is usually unilateral. It may be due to obstruction within the ureter, *e.g.*, stone, tumor, blood-clot, stricture, to angulation of the ureter, *e.g.*, nephroptosis, or traction by tumors within the pelvis, or to pressure from without, *e.g.*, by the pregnant uterus, by carcinoma, by appendical or other abscesses, etc.

Urethral retention causes infection of bladder and both kidneys. The infection may, however, be mild in one kidney, acute in the other. The acute infection may have for its accessory cause only the urethral retention. But there may arise a secondary ureteral cause of retention, such as a kink. In order to relieve such renal retention it is necessary to relieve not only the urethral but also the ureteral obstruction.

The one flaw in this mechanical theory of renal infection is the infection of the opposite kidney. Not only is pyelonephritis almost always bilateral, but acute infection of one kidney is almost always associated with mild infection of its fellow. This mild infection of the opposite kidney is doubtless due to toxic rather than to retentative causes.

Trauma.—Trauma includes not only the open wound and the obvious contusion, but also the trauma of stone, the trauma of slight wrenches and unnoted bruises, and, above all, the trauma of urethral instrumentation which is so large a cause of infection.

Toxic Influences.—We may note in passing that certain renal toxemias do not appear to predispose the kidney to bacterial infection. Bright's disease,

whether acute or chronic, does not appear to make the kidney a good soil for bacterial growth. Tuberculosis of one kidney often produces a toxic nephritis in its fellow, and not infrequently this intoxicated kidney is mildly infected with *Bacillus coli* or the pyogenic cocci. But I have never seen a grave infection under these circumstances.

But, as suggested in the preceding section, retention is not by any means the whole story in the accessory causation of renal infection. Thus in certain instances it is quite obvious that the hyperacute renal infections of infants are due to abscesses or infections elsewhere in the body. The frequency of mild renal infection in the course of typhoid fever, and the readiness with which this infection gets well, both show that the intensity of the toxemia has much to do with causing the renal congestion that causes kidney infection. The preponderance of bilateral *Bacillus coli* infection tells the same tale. Yet if we accept the doubtful case of children these toxic influences may be blamed rather for mild, chronic bilateral infections than for the more acute ones which require treatment. Indeed, it is an open question whether acute attacks of renal infection are not like acute attacks of Bright's disease, mere incidents in the course of a chronic, perhaps unsuspected, infection.

Hinman has proved the existence of a renal counterbalance whereby the disease in one kidney impairs the function of its fellow and has further shown that a kidney gravely diseased, yet adequate to support life, will continue to lose function month by month so long as its fellow is substantially normal. But if this fellow is removed and the experimental animal survives the operation, the function of the remaining kidney, which was previously slowly deteriorating, will now take on a renewed capacity, an increased flexibility, an improved function. Such improvements in renal function are interfered with by infection, *i.e.*, the more inflamed the impaired kidney is, the less it will rally under physiological stimulants.

Such physiological impairments of function, even though they be only strains, render the kidneys more liable to infection. Thus a mild *Bacillus coli* pyelonephritis is usually found in the kidney opposite one acutely inflamed or pyonephrotic.

SUMMARY

Apart from the tubercle bacillus, the important infecting microörganisms of the urinary tract may be divided into two groups. On the one hand, the colon group causing 90 per cent of the infections of the pelvis of the kidney. On the other hand, the pyogenic cocci which predominate in perinephritic abscess and divide with the colon group the etiology of infections of the bladder.

Mixed infections are common.

The commonest mode of infection is by an initial inflammation of the kidney parenchyma through bacteria derived from the blood stream.

Ascending infection from the bladder to the kidney does not ascend as a surface infection along the ureter. It may occur along the lymphatics of the ureter. It probably occurs with great frequency by absorption from the prostate or bladder into the general circulation, and reëxcretion of bacteria through the kidney. It is, therefore, actually a descending infection.

The presence of bacteria in the circulating blood does not necessarily entail a renal infection.

Bilateral renal infection is doubtless often due to a toxic accessory cause. Unilateral infection is usually due to a mechanical accessory cause, and this is most frequently some form of retention.

The accessory causes, more than any other factor, determine the acuteness of the infection and its pathological development.

CHAPTER XIV

ETIOLOGY AND PATHOLOGY OF RENAL INFECTION

The phenomena of renal infection are due to a bacterial cause. But clinically they present the widest variety, both in intensity and in duration. No contrast could be greater than that between microscopic bacteriuria and a hyperacute focal suppurative nephritis. Yet the one may, under appropriate circumstances, be transformed into the other.

We are obliged to consider the lesions of pelvis and parenchyma separately. Indeed, in the preceding chapter we have spoken of infection reaching the kidney parenchyma first and then the pelvis. Yet clinically speaking inflammation of the pelvis of the kidney means inflammation of its ureter, and of the kidney parenchyma as well; while inflammation of the kidney parenchyma without some inflammation of the kidney pelvis is characteristic of the septic infarct. Thus the lesions described below form only the various parts and phases of a single picture of what we know as renal infection.

The lesions of renal infection may be classified as follows:

1. Acute suppuration of the kidney
   - (*a*) The pyemic kidney
   - (*b*) Acute suppurative nephritis
   - (*c*) The septic infarct
2. Acute pyelitis
3. Chronic pyelonephritis
4. Pyonephrosis
5. Infected hydronephrosis
6. Perinephritis
   - (*a*) Fibrolipomatous
   - (*b*) Suppurative
7. Rare inflammatory conditions of the renal pelvis
   - (*a*) Pyelitis granulosa
   - (*b*) Malacoplakia
   - (*c*) Pyelitis cystica
   - (*d*) Leukoplakia
   - (*e*) Incrustation

ACUTE SUPPURATION OF THE KIDNEY

The Pyemic Kidney.—By the pyemic kidney we understand a condition of multiple suppurating points in both kidneys. The abscesses are chiefly in the

cortex. The renal lesion is only part of a general pyemia. Consequently the patient dies before the lesions are far advanced or have ruptured into the perinephritic space or into the kidney pelvis. The lesions manifest themselves only by interference with the kidney function; the diagnosis is made post-mortem; the condition has no clinical interest.

There is also a clinical type of renal infection which might be called the septicemic kidney. It is a pyelonephritis occurring in the course of a septicemia. It is seen in its most characteristic form in the course of unsuspected septicemia of which the outstanding clinical characteristics are those of an acute nephrosis. The patient, usually an adolescent, becomes weak and anemic. Examination discloses a very slight elevation of temperature, so slight as often to be disregarded, a marked secondary anemia, a grave renal deficiency, marked renal exudation, with albumin and casts, and slight evidence of renal infection, with bacteria—often streptococci—and a few pus cells in the urine. The albumin and casts in the urine and the secondary anemia so predominate the clinical picture that the slight elevation of temperature, the bacteria and the pus in the urine, are overlooked, and the blood culture not made. The patient is solemnly put upon a protein-free diet and the opportunity to combat the infection by sunlight, overfeeding and repeated transfusions overlooked until too late.

The lesion of the kidneys in such cases is a chronic pyelonephritis, secondary, it is true, yet of the greatest clinical importance as affording the clew to the diagnosis.

Acute Suppurative Nephritis.—The pyemic and septicemic kidneys are types of acute suppurative bilateral nephritis incident and subordinate to general infection. There are two other types of acute renal suppuration, each of them characteristically localized in one kidney and each the source rather than the effect of general septic infection. The one is so special in etiology, pathology and clinical course that it is better considered apart under the title of septic infarct, the other is an acute suppurative pyelonephritis occasioned by local conditions.

It is often the result of trauma, *e.g.*, contusion of or operation upon the kidney, ureter catheterism or lavage of the renal pelvis; it is the pyelonephritis of pregnancy, of infancy; the acute pyelonephritis of calculous disease and of prostatic retention.

If mild, the lesion consists of little more than an acute generalized parenchymal congestion and degeneration, accompanied by an acute pyelitis. When more acute, these lesions are interspersed with wedge-shaped areas of miliary abscess formation, spreading by lymphatic absorption from initial points of necrosis near the papillæ. These wedge-shaped lesions were mistaken by Brewer for infarcts, whence the name "multiple septic infarcts" erroneously allotted to them. A better descriptive title for these lesions is focal suppurative nephritis, though actually they are no more than an accentuation of acute infection of the kidney.

The infection is usually due to Gram-negative bacilli, rarely to pyogenic cocci.

The usual outcome is absorption of the products of inflammation, even though this appear improbable in view of the number and extent of the abscesses. Many a kidney has been shown as proof that nephrectomy was absolutely indicated, though the specimen shows no such thing, but only a kidney that might have been expected to get well with quite adequate function if proper treatment had been applied to remove the occasion of infection.

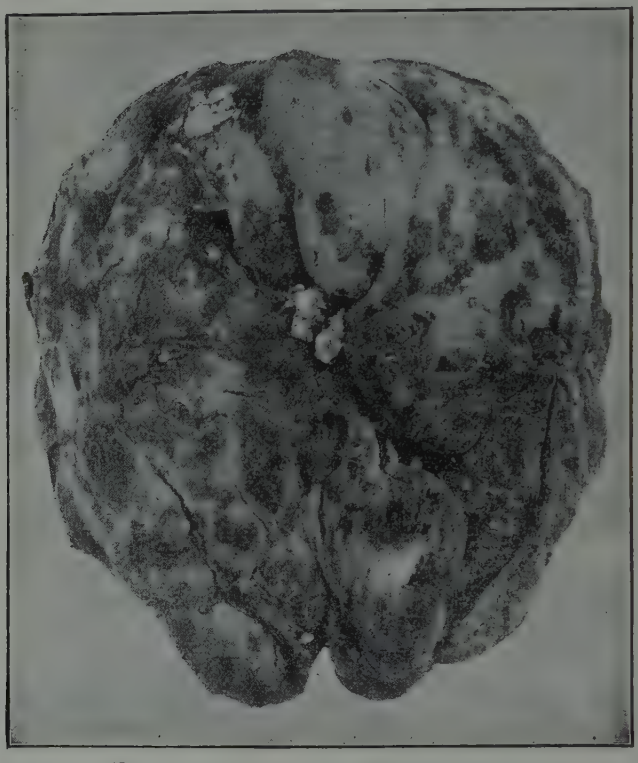

FIG. 50.—FOCAL SUPPURATIVE NEPHRITIS.
The kidney is split and seen from without. It is mottled by groups of miliary abscesses. Vessels and ureter in center.

Exceptionally, however, the infection is so acute as to require nephrectomy. Figure 50 illustrates a kidney that had to be removed, Plate VI one that perhaps did not. Figure 51 one that certainly did not, and Plate VII shows one in which the abscesses had broken down, requiring an ultimate nephrectomy.

The suppuration rarely extends beyond the capsule to form perinephritic abscess.

The Septic Infarct.—The lesions due to septic infarction so closely resemble those of severe acute pyelonephritis that it took clinical observation to distinguish the one from the other. The infarct, as its title indicates, is a

PLATE VI.—ACUTE SUPPURATIVE NEPHRITIS.

Central portion of parenchyma is grossly normal but at each pole are seen various lesions of acute infection, strings of abscesses following lymphatic channels, in one place a completely broken down portion of kidney tissue projecting from the surface in the form of the so-called "carbuncle" and in the pelvis and calices various degrees of congestion and ecchymosis.

In as much as the ureter was not obstructed, this kidney might have been saved by decapsulation, blunt excision of the carbuncular lesion and a rather prolonged convalescence for drainage of the other lesions.

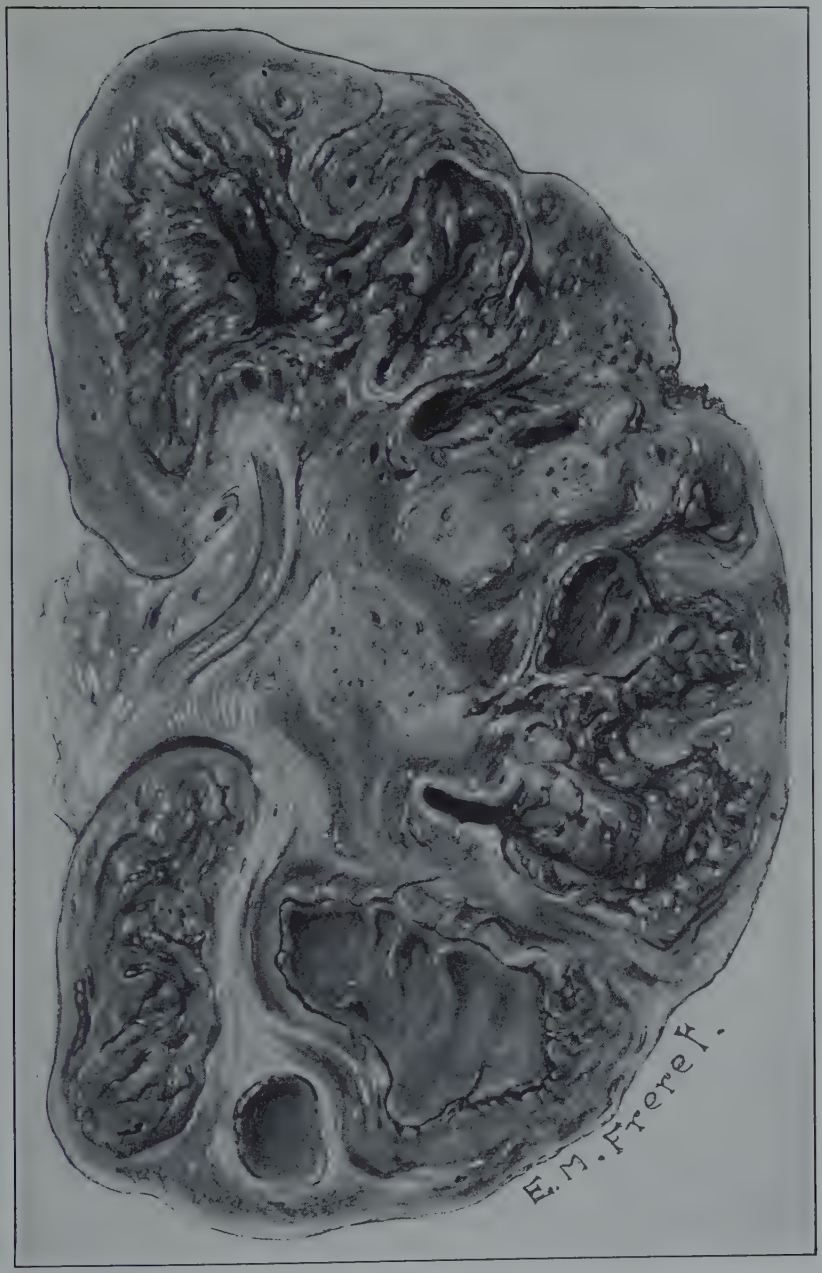

PLATE VII.—CHRONIC PYELONEPHRITIS DUE TO NEGLECT OF ACUTE SUPPURATIVE NEPHRITIS.

The kidney leaks like a tuberculous one. The pelvis is contracted. The region about it infiltrated with scar and sclerotic fat. The kidney substance has disappeared, being replaced by septa of scar and fat surrounding suppurating cavities derived from parenchymal abscesses and dilated calices. The lesion has become pyonephrotic.

parenchymatous suppuration due to the lodgment of a purulent embolus in one kidney. The embolus usually originates in a focus of skin suppuration, the bacteria are always cocci. The lesion, though resembling the one above described in that it is a focus of miliary suppuration in the parenchyma, shows the following very distinguishing characteristics: It does not involve the kidney pelvis. It is usually situated in the cortex. It breaks through the capsule to form perinephritic abscess (Fig. 51).

FIG. 51.—A SEPTIC INFARCT THAT LED TO PERINEPHRITIC ABSCESS.

The kidney surrounded by perirenal fibrolipoma is split. The pelvis is normal. The parenchyma is normal excepting at the upper pole which is occupied by an irregular broken-down area surmounted by the abscess, where the perirenal fat comes to an end.

Acute Pyelitis.—Acute inflammation of the pelvis of the kidney without inflammation of the parenchyma doubtless never occurs except as the result of trauma by the ureter catheter or by pelvic lavage.

It is customary to refer inaccurately to the milder forms of acute pyelonephritis as acute pyelitis because they show such slight evidence of involvement of the parenchyma.

The more acute infections of the kidney pelvis often are due to that combination of infection and trauma that results from stone. Under these circumstances gangrene and rupture of the pelvis may occur.

CHRONIC PYELONEPHRITIS

The mildest type of chronic renal infection, *renal bacteriuria,* produces lesions so slight that they have not been precisely identified. Crabtree believes the foci of chronic infection lie just beneath the mucosa of the pelvis of the kidney, about the calices.

More severe cases of long duration exhibit a kidney adherent in more or less fibrolipomatous perinephritis. The organ itself may be not far from normal in size, but the pelvis and ureter are likely to be thickened, dilated, and also surrounded by adherent sclerotic fat. This moderate dilatation of the kidney pelvis and ureter occurs independently of any recognizable ureteral obstruction. On section the kidney markings are lost, its tissue rather pale and fibrous in character, the cortex thin, the papillæ flattened in the dilated calices. The surface of the pelvis and ureter may show a glazed or granulating appearance or may manifest any of the unusual changes to be later described.

The microscope reveals destruction of the kidney parenchyma by sclerosis, pyogenic infiltration, and degeneration. Similar microscopic lesions are found in the kidney pelvis and ureter.

The ultimate outcome of this chronic sclerosis is to leave the kidney little more than a pyonephrotic shell (Plate VIII).

Stone is a common cause and complication of pyelonephritis.

PYONEPHROSIS

Pyonephrosis is a term somewhat loosely applied to cover two differing conditions.

One of these is the relatively acute condition developing as the result of retention combined with infection. The retention causes dilatation of the kidney; the infection, while not sufficiently acute to cause any marked gross distortion of the renal parenchyma, produces a relatively thick pus within the kidney pelvis, and a relatively rapid sclerosis of the kidney parenchyma. If such a case is operated upon early, the kidney is found imbedded in a thick edematous mass of perirenal fibrolipoma. The organ itself is much distended. The ureter as a result of dilatation, thickening of its walls, and perirenal adhesive inflammation, may be as big around as the finger. On section, thick pus flows from the dilated renal pelvis, the renal parenchyma shows marked lesions of chronic pyelonephritis, perhaps interspersed with foci of acute infection.

The other, or chronic type of pyonephrosis, is the result either of a mild infection in a dilated kidney or simply the end phase of severe chronic pyelonephritis. In such cases, though the renal pelvis be considerably dilated, the parenchyma is so much shrunken that the total mass of kidney may be actually smaller than the normal; usually, however, it is much larger than normal, and may attain enormous size. The dilated pelvis is often only a scar

in which it is impossible to distinguish where pelvis ends and kidney begins. The fibrolipomatous perinephritis assumes enormous proportions, so that the kidney lies embedded in a dense fatty capsule which may be several centimeters thick. Indeed, on section it may be found that the very renal parenchyma itself has been replaced by fat, so that in the most extreme cases of this type the kidney pelvis is capped, not by renal parenchyma, but by its semblance in lobules of dense yellow fat (Plates VII, VIII).

INFECTED HYDRONEPHROSIS

The infective lesions are those of pyelonephritis, the essential lesion that of hydronephrosis as described in Chapter XXXIII.

PERINEPHRITIS

Fibrolipomatous Perinephritis.—Fibrolipomatous perinephritis is the aseptic reaction of the perinephritis tissue to the lymphatic distribution of infection from bacterial processes within the kidney. The earliest reaction found upon operation upon acute cases of renal infection is edema of the fibrofatty envelope. As the process becomes chronic, this edema is replaced by scar, binding the perirenal tissues to the fibrous capsule of the kidney, and enveloping masses of dense yellow fat, very different from the normal soft, white perirenal fat. This protective perinephritic reaction has little clinical interest, excepting in so much as it markedly increases the difficulties in nephrectomy for old renal infection. In ancient cases it envelops in a thick mass the kidney, the pelvis, the ureter, and the pedicle, and in some instances it even replaces the kidney tissue itself, so that the line of demarcation between kidney and perirenal fibrolipoma is but a thin line of scar, which is all that remains of the kidney capsule.

Suppurative Perinephritis.—Although clinically the distinction cannot always be made, we must recognize the pathological difference between true perinephritic abscess, *i.e.*, suppuration within the fascial capsule of the kidney, and false perinephritic abscess occupying the retroperitoneal fat, but originating outside of the perinephritic fascia, and more properly termed subdiaphragmatic or paranephritic abscess. True perinephritic abscess probably always arises from some lesion of the kidney cortex, usually a septic infarct (Plate VIII, Fig. 6). False perinephritic, or subdiaphragmatic, abscess is due to suppuration in the surrounding viscera or parietes.

As already stated, the pyogenic cocci predominate in the pus. Thus Miller [1] found staphylococci in twelve cases, streptococci in two, streptococci and pneumococci in one, *Bacillus coli* in six, and two were sterile. Not counting the sterile cases, this series shows 71 per cent of pyogenic cocci as against 24 per cent *Bacillus coli;* quite the reverse to the statistics for pyelonephritis.

[1] *Ann. Surg.*, March, 1910.

The perirenal fascial envelope usually permits the suppuration within it to extend only through its open lower end. Thence it passes forward over the ileum, and even into the true pelvis. If neglected it may burst into the intestine, or the bladder, or through the skin, or it may even pass upward through the fascial envelope and rupture into the pleura or lung.

RARE INFLAMMATORY CONDITIONS OF THE RENAL PELVIS

The following conditions may all occur in the pelvis, the ureter, or the urinary bladder. All of them are rare; all of them appear to have some relation to chronic bacterial infection and inflammation of the pelvis and bladder.

Pyelitis Granulosa.[2]—Pyelitis granulosa or follicularis is a lymphoid infiltration of the mucous membrane of the kidney pelvis. It is apparently the result of chronic pyelitis, though it is said to have been found postmortem in uninfected cases. The pelvis presents a rough and pebbled gross appearance. The microscope reveals little aggregations of lymphoid tissue in the mucosa. They are vascular, and show a tendency to capsule formation. The larger ones may ulcerate. They usually produce no symptoms. They may bleed or deliver pus.

Malacoplakia.[3]—This consists in grayish or yellowish nodules made up of large cells, 20μ in diameter, containing colon bacilli, leukocytes and peculiar cell inclusions. These nodules may be found in the renal parenchyma as well as on the mucous membrane of the urinary reservoir.

Pyelitis Cystica.—This condition, like the preceding two, is usually associated with chronic inflammation. It is commoner in the bladder than in the pelvis of the kidney. The lesions are usually multiple, and vary from small red elevations on the mucous membrane that look precisely like pyelitis or cystitis granulosa, to larger bodies that when seen through the cystoscope in the bladder, for instance, or observed in the kidney pelvis postmortem, look distinctly cystic. The cysts apparently never attain a very great size. Under the microscope the lesion looks very much like a papilloma, with the difference that the true neoplasm springs from the surface of the mucous membrane, and projects above it, while cystitis cystica is, as it were, inverted, and digs under the epithelial surface of the mucosa. The larger lesions are frankly cystic (Plate XIII).

Leukoplakia.[4]—Leukoplakia occurs much more rarely in the bladder than on the tongue, much more rarely in the kidney pelvis than in the bladder. No relation has been established between urinary leukoplakia and syphilis. Published reports do not suggest any tendency to malignancy, although leukoplakia of the urethra is said to be a malignant condition. I have seen two cases of leukoplakia in the bladder, the lesions occupying the fundus, and the regions

[2] Kretschmer, *Surg., Gynec. & Obst.*, 1913, xvii, 612.
[3] MacDonald and Sewell, *J. Path & Bacteriol.*, 1914, xviii, 306.
[4] Briggs and Maxwell, *J. Urol.*, 1926, xvi, 1.

back of the ureter mouth. I have twice seen leukoplakia of the kidney pelvis. The bladder lesions resemble those seen upon the tongue, a whitish, thick, epithelial, flat surface with a reddish border, while here and there in the vicinity are seen reddish lesions of chronic inflammation upon which the squamous epithelium has not yet collected in sufficient quantities to give them the white color.

Calculous Incrustations.—Phosphatic incrustation upon an ulcerative inflammatory lesion is always due to ammoniogenic bacteria, usually the pyogenic cocci or the proteus. Phosphatic incrustations are also seen on the renal lesions of tuberculosis. Indeed, this is the commonest form of incrustation in the kidney pelvis.

CHAPTER XV

THE CLINICAL PICTURE OF RENAL INFECTION

Infection of the kidney often first shows itself by an acute febrile attack. This may be so mild as to escape diagnosis or so severe as to prove fatal within a few days. Usually it subsides in time, however, leaving the patient with chronic pyelonephritis. This in turn should promptly subside unless some local occasion of lessened resistance keeps it going. It may be so mild as to be to all intents and purposes harmless, or if complicated by retention, stone, trauma, etc., its course may be interrupted by outbreaks of acute infection, and it terminates in pyonephrosis.

Certain of the lesions described in the preceding chapter scarcely interest us as clinicians. Thus the pyemic kidney kills without renal symptoms other than those of a rapidly progressive loss of renal function, and the various rare lesions of the renal pelvis are rather pathological curiosities than clinical entities.

ACUTE RENAL INFECTION

Under this title we may group the lesions variously described as acute pyelitis, acute pyelonephritis, focal suppurative nephritis, septic infarcts, etc., for these are but milder or severer examples of a single pathological process.

The one common symptom of all these conditions is *fever*. The cases may be classified as mild, severe, and fulminating.

Mild Cases.—The dominant symptom is either fever, pain or derangement of the digestion. These may occur alone or in combination. The fever is due to retention, sometimes in the kidney pelvis, or even in a single calix; more often parenchymal, in the form of the wedge-shaped lymphatic-distributed areas of miliary suppuration described in the preceding chapter.

The pain is due to tension, pelvic, calical, parenchymal. The painful spot is tender. Indeed, these milder cases often exhibit tenderness without pain. Kidney pain centers in the mid-axillary region and loin, whence it radiates obliquely downward and forward to the external genitals and also to the antero-lateral portion of the thigh. Kidney pelvis pain centers just external to the rectus abdominis at about the level of the umbilicus. On the right side it is thus a little high for an appendix and a little low for a gall-bladder. From this point it radiates as does kidney pain.

The digestive symptoms are due to renal deficiency. When mild they consist in anorexia, constipation, thirstiness, flatulence, colon tenderness and pain due to distention. Unless renal function tests are taken daily these show no

reading to correspond with the actual degree of renal inefficiency to which these symptoms bear witness; *i.e.*, the symptoms are a more delicate test of renal inefficiency than is the laboratory.

Most acute infections of the kidney are due to accidental circumstances rather than to the specific organotropic character of the infecting micro-organism. Hence the duration of the acute phase of the infection may be brief. A chill and a few hours of fever may, for example, constitute the whole attack. Or repeated outbreaks of fever, with or without pain and toxic symptoms, may occur now and again in the course of a chronic pyelonephritis. Indeed such acute outbreaks may be the sole clinical evidence of the existence of chronic renal infection.

Among the briefer and milder clinical types of acute renal infection may be mentioned the following:

A sound, cystoscope or ureter catheter is passed. An hour or two later the patient urinates and immediately thereafter has a chill and rise of temperature which, though it may be unimportant, is likely to touch 105° or 106° and to come down almost as quickly as it went up, so that after the patient sweats off his toxic symptoms of delirium, vomiting and prostration, and the family recovers from the shock, he is promptly as well as ever. This acute pyelonephritis has long gone by the name of urethral chill. It was supposed by the ancients to be an infection of the prostate or urethra. A generation since it became evident from urinalysis and the results of renal function tests that "urethral chill" is actually a renal infection. We have not yet learned how this renal infection usually comes about. Ureteral cases we readily understand, for if the symptoms do not abate we have learned that a second very gentle passage of the ureter catheter will detect a point of obstruction, deliver a gush of retained purulent urine and, if the obstruction has been wholly relieved, cure the acute infection. But the explanation of the urethral cases is not so easy. Sometimes the urethral chill turns out to be a pneumonia; then we conclude that the infection is metastatic from an infected prostate. Crabtree's illustration of how such metastatic infection may reach the kidney has been mentioned in Chapter XIII. Quinby and Graves insist that their animal experiments show the infection to be by direct regurgitation of infected urine from the bladder up the ureter and into the renal parenchyma. The fact that the chill characteristically follows immediately upon the first postinstrumental micturition lends color to this theory, which has the added interest of supplying a single theory to explain both ureteral and urethral chill, two conditions that clinically resemble each other very closely.

Severe Cases.—Severe acute renal infection is but an intensification of the mild acute infection described in the preceding paragraphs. The attack begins with a chill, and proceeds with an irregular septic temperature, leukocytosis, impairment of renal function, and pus, albumin and bacteria in the urine.

The dominating feature of the clinical picture, apart from the fever, is pain and tenderness in the loin. The pain is usually so severe that the patient

complains of it, the tenderness in the kidney may be elicited by ballottement, even when the kidney itself is impalpable. As a rule the kidney is palpably enlarged, as well as sensitive.

There may be an initial hematuria suggesting tuberculosis.

Fulminating Cases.—In the most severe cases, however, the intense sepsis overshadows all other symptoms. The kidney is exquisitely sensitive to pressure, but the pain is felt rather as a general sensitiveness of the upper abdomen than as a pain in the loin. Such truly fulminating attacks are likely to be mistaken for some form of peritoneal sepsis which is due to appendicitis or cholecystitis. They are readily differentiated by the exquisite kidney tenderness. But the clinical picture is that of the "acute abdomen" and if the lesion is a septic infarct with no pus or bacteria in the urine, only a few easily overlooked red blood-corpuscles, the kidney is not thought of as the seat of the lesion and the patient dies septic without diagnosis. Though this is the lesion so brilliantly described by Brewer, the most severe cases are the very ones that are overlooked. The peritoneal cavity is explored in vain and even then the kidney is not suspected.

Septic Infarct.—The septic infarct, or carbuncle of the kidney, is a thing apart, both clinically and pathologically. It is almost always a complication of staphylococcus skin infection, and the fact that it is an embolus is suggested by the sequence—operation, kidney infection. The skin infection may be a slight one and the symptoms of secondary kidney infection may not develop until a week or more after the subsidence of the skin lesion.

The infection may follow the fulminating type just described, but more often it is very mild at first, in which case the backache may be so mild as to be attributed to the irregular fever. The leukocytosis proves the presence of septic infection, but unless the back is carefully palpated the renal lesion is overlooked. The urine contains a few red blood-corpuscles at first but these may disappear, leaving the urine quite normal. Even the fever may all but disappear, but it recurs irregularly. The abscess in the kidney grows, but may take weeks before it ruptures through the fibrous capsule and forms a perinephritic abscess (Plate VIII, Fig. 6).

This in turn may grow rapidly or slowly. Fortunately it tends to gravitate toward the lower pole where it is readily diagnosed. If it remains about the upper pole the diagnosis can perhaps not be made except by radiographic evidence of restricted mobility of the diaphragm.

Small septic infarcts doubtless sometimes heal undiagnosed. But so far as we know those that develop sufficiently to excite important symptoms always lead to perinephritic abscess and this does not heal until it is drained. Yet if the infection progresses slowly the abscess may remain so small as to escape diagnosis for months. I once saw a patient who had suffered for six months with so slight a fever and so persistent a tenderness in his loin that he was almost given up as an incurable neurasthenic when he happened under my care. Yet his history from boil to backache was typical. He was exquisitely hyper-

esthetic from ribs to pelvis. I operated, expecting to find a large loin abscess, but under the relaxation of anesthesia the rigidity disappeared, no mass could be felt in the loin and incision revealed an abscess at the lower pole of the kidney containing no more than 5 c.c. of pus.

CHRONIC PYELONEPHRITIS

Chronic pyelonephritis usually begins with an acute febrile attack, though this may be so mild as to be overlooked. It continues under one of three types:

1. Bacteriuria or pyuria without symptoms
2. Painful symptoms, with pyuria
3. Toxic and septic symptoms, with pyuria

These clinical types are not mutually exclusive. Indeed, many patients during the greater part of the course of their disease suffer no subjective symptoms at all, and may be classed under the first type. But more often they not only develop painful symptoms or septic or toxic symptoms, but also may suffer intercurrent attacks of acute infection. The more acute attacks are likely to occur in one kidney, yet not only is it almost the universal rule that both kidneys are infected, but it is also quite usual that the diminution of function is almost as marked in the silent kidney as it is in the painful or tender kidney. Such cases are manifestly poor subjects for nephrectomy.

Stone, either primary, as a cause of infection, or secondary, as a result of infection, is a very common complication of chronic pyelonephritis.

The prognosis of these chronic renal infections is bad. The milder types are indeed curable, and even if not cured may continue for many years without gravely impairing the patient's health. So long as the kidney drainage is good, the patient may scarcely call himself sick, although he may have had an active chronic pyelonephritis for many years. Complicating stone, even though this grow to an enormous size, and thereby hasten the destruction of kidney parenchyma, does not portend an immediate fatal issue unless the stone obstructs the ureter, a thing which it is likely ultimately to do. But I have known several cases to continue in very good health for thirty or forty years, even with stone.

The ultimate outcome of chronic renal infection is, however, the total destruction of the kidney parenchyma by chronic inflammation. If retention predominates over infection, the result is infected hydronephrosis. If, as is more commonly the case, infection predominates over retention, the result is pyonephrosis.

Bacteriuria

Bacteriuria [1] is a clinical rather than a pathological condition. The bacteriuria is spoken of as partial when the bacteria are derived from the prostate and the

[1] Ten Broeck, *Surg., Gynec. & Obst.*, 1916, xxii, 349.

urine from the kidneys is uninfected. Bacteriuria is total when caused by a lesion in the kidney pelvis.

The bacteria may be so few as not to produce any pus, not to cloud the urine, and not to be discernible even by smear. Only culture reveals them. Such a condition may exist quite unsuspected for many years. Indeed, many acute renal infections in young children, though they apparently terminate and leave the patient in perfect health with no visible pus, bacteria or albumin in the urine, actually continue in this occult type of bacteriuria. Let such a patient be subjected to trauma or retention, and acute renal infection promptly occurs.

Ross,[2] for example, made a bacteriological study of 106 children's urines. He found forty-three cases of *Bacillus coli* infection. Among these only three had a frank pyuria, twelve had a pure bacteriuria without pus, and six revealed bacilli only to culture. Among nineteen supposedly normal cases, eight were contaminated with *Staphylococcus albus.*

The condition commonly spoken of as bacteriuria, however, is that in which the urine is swarming and clouded with bacteria, but contains no more than a few pus cells. Like the condition just described, it is actually a form of mild pyelonephritis, and if the case is closely watched for a considerable time, and repeated urinalyses made, pus will be found in the urine from time to time. Indeed, a transitory bacteriuria may be noted at the onset and close of many acute attacks of renal infection.

The bacteria of bacteriuria are those of renal infection. Thus Suter[3] collected 169 cases showing *Bacillus coli,* thirteen showing staphylococci, nine showing streptococci, and six showing other bacteria.

Bacteriuria is usually symptomless. But it may cause any of the symptoms of pyelonephritis.

Pyuria

Pyuria without symptoms is evidence of an infection somewhat more grave, and more progressive than that which causes simple bacteriuria.

Urinalysis of the urine obtained from a case of total or renal bacteriuria usually shows a trace of albumin and sometimes a few casts and epithelial cells from the kidney pelvis. But these may be absent. When the inflammation is severe enough to cause pyuria, however, there is always a trace of albumin in the urine, usually some cells from the kidney pelvis, rarely casts.

The absence of casts, so characteristic of all forms of surgical infections of the kidney, and so strikingly different from the condition in medical nephritis, merits attention. A long and careful search of several specimens of urine will indeed usually be rewarded by the finding of a few casts, even in surgical cases. But these casts when found are more likely to be hyalin or granular

[2] *Lancet,* 1915, clxxxviii, 654.
[3] *Tr. III. Internat. Urol. Ass.,* 1914.

than pus casts. Therefore it seems probable that they are due rather to an associated toxic nephritis than to the actual bacterial processes in the kidney parenchyma. Be this as it may, *the characteristic urine of renal infection does not contain casts.*

Painful Symptoms

The characteristic pain of acute renal infection has been described. Such pain may exist with chronic pyelonephritis; but this is unusual. The pain may be felt rather in front than behind and may be referred to the gall-bladder or appendix region, or to corresponding points on the left side.

The characteristic pain of *chronic* infection of the kidney is *frequent and painful urination.* This frequent urination is apparently due to the inflammation of the kidney pelvis and ureter. The cystoscope shows that it is not associated with inflammation of the bladder, yet the symptom of frequent and painful urination, whether due to simple pyelonephritis, stone in the ureter, tuberculosis of the pelvis of the kidney, or to cystitis, has no distinguishing characteristic. The cause of the frequent and painful urination can be diagnosed only by the cystoscope. This frequency is more commonly associated with calculous or tuberculous pyelonephritis than it is with the type of which we are now speaking.

Toxic Symptoms

Toxic symptoms are a measure of renal retention or of renal insufficiency due to the sclerosis of infection rather than of renal infection itself. The toxemia of renal infection shows itself in five types:

Digestive symptoms
Cerebral symptoms
Hiccough
Rheumatism
(High blood-pressure)

Digestive Symptoms.—Superficially the digestive symptoms resemble those of so-called chronic indigestion. The bowels are constipated, the patient thin, sallow and anemic, the appetite fanciful, and the patient usually complains of various abdominal discomforts, lassitude and loss of weight. But the striking feature of this indigestion is what the French call *"buccal dysphagia"*; subjective if the toxemia is mild, objective if it is severe. In mild cases this amounts to little more than a dryness and stickiness about the tongue and the pharynx which the patient may vainly endeavor to control by drinking large quantities of water.

In the severe cases, the tongue not only feels dry, but is visibly dry, parched, red, pointed, and may even be cracked and fissured. It may be thickly furred.

The condition of the tongue is one of the most dependable physical signs in the prognosis of urinary infection. As the renal function is more and more impaired, the tongue and pharynx grow drier and drier; while if improvement occurs, the moistening of the tongue is often one of the first signs of this.

When the tongue is moderately dry the patient actually cannot eat dry solid food. If the tongue is excessively dry, he cannot, except with difficulty, swallow fluids.

Cerebral Symptoms.—Cerebral symptoms, arising from renal infection, belong rather to pyonephrosis than to pyelonephritis. Yet the very rarity and obscurity of such symptoms when arising without an evident septic cause is enough to make them remarkable in this connection. Cerebral symptoms indicate grave inhibition of the renal function.

The cerebral symptoms, if mild, consist of little more than an undue irascibility and inability to sleep, with some tendency to headache. If more severe, the patient becomes flighty at night, but is likely to be quite rational during the day. Rarely there may be attacks of excitement approaching the maniacal. The most severe symptoms are seen only in connection with the digestive symptoms, and the characteristic dry tongue.

Hiccough.—Persistent hiccough, like the dry tongue and the cerebral symptoms, is an ominous sign of grave impairment of the renal function. Such being the case, we may remark parenthetically, that it is quite futile to attempt to treat persistent hiccough by any remedy excepting diuresis.

Rheumatism.—Although toxic pains in various parts of the body form part of the picture of any grave toxemia, metastatic arthritis of any importance is not usually of renal origin.

High Blood-Pressure.—High blood-pressure is often allied with the toxemia of non-bacterial nephritis. This may well be associated with bacterial nephritis, but the toxemia of the latter does not cause elevation of the blood-pressure. Renal retention at first raises and later, as the vitality fails, lowers the blood-pressure.

Septic Symptoms

The septic type of renal infection, urinary septicemia or urosepsis, by which name it is more familiarly called, is an infection characterized by an irregular temperature which, when severe, is likely to be associated with chills and a fever curve of the picket-fence type, usually accompanied by some of the toxic symptoms above described, notably the buccal dysphagia, and which, like any other sepsis, depends for its intensity, its gravity and its continuance upon the virulence of the infective microörganism, and its confinement and absorption.

Urinary septicemia has no distinguishing characteristics, excepting its tendency to produce a buccal dysphagia and the fact that it is associated with impairment of the renal function, pyuria and albuminuria.

The one striking characteristic of the fever due to renal infection is the height to which it can rise without doing the patient any appreciable harm. Thus urethral or ureteral chill often goes to 105° or 106° and does the patient no more harm than a malarial chill of equal intensity. Indeed in children malaria and renal infection are the commonest obscure infections that excite such high temperatures. Similarly, during the course of any renal infection very high temperatures occur from time to time and even recur for several days without necessarily threatening life.

Such high temperatures suggest acute suppuration of the parenchyma which will abate spontaneously unless due to retention or to septic infarcts, but may be due to prostatitis, pneumonia, etc.

SYMPTOMS OF PYONEPHROSIS

In its clinical picture pyonephrosis combines the symptoms of chronic pyelonephritis with urosepsis, and sometimes with the more acute symptoms of acute renal infection.

The striking symptoms are usually those of urinary septicemia: mild toxic symptoms if the infection is of low virulence; severe septic symptoms if it is more active.

The Urine.—The urine of pyonephrosis always contains pus. For though the pyonephrosis itself may be closed, the opposite kidney is usually infected. If, as is usually the case, the pyonephrosis is open and delivering pus into the bladder, this pus will often be discharged intermittently. The pus thus delivered is thick, ropy, greenish and settles to the bottom of the urine in a flat mud quite different from the pus of the milder renal infections, and notably different from the lighter pus of cystitis. The renal function is always notably impaired, and even the mixed urine is usually watery and of low specific gravity.

Cystoscopy.—This reveals a dilated distorted ureter mouth surrounded by inflammation, though exceptionally this inflammation of the ureter may have subsided, and its mouth look not far from normal, or a golf-hole or retracted, tunnel-entrance ureter mouth. If the pyonephrosis is discharging pus at the time of the cystoscopy, this pus is likely to appear as a thick, white ribbon drooling from the ureter. If ureter catheterization is possible, in spite of the various kinks and scars in the ureter, the urine obtained from the kidney may show a surprisingly large percentage of urea, as high as 1.5 per cent. But the phenolsulphonephthalein output from the pyonephrotic kidney is no more than a trace.

The opposite kidney will habitually be found infected. Sometimes its function will be found gravely impaired.

Palpation of the Kidney.—Palpation of the kidney which reveals little enlargement in most cases of pyelonephritis, usually discloses a very large and sensitive kidney. The increased size of the kidney may be due to the large size

of the pyonephrotic sac, but often it is due to the great mass of perirenal fibrolipoma.

There may or may not be pain and tenderness in the loin.

SYMPTOMS OF PERINEPHRITIS

Fibrolipomatous perinephritis produces no symptoms.

Suppurating perinephritis, a perinephritic abscess, produces a clinical picture similar to that of acute renal infection. Indeed since the perinephritic abscess originates, as a rule, in an acute cortical abscess of the kidney, it is quite futile to attempt to distinguish the two too precisely in their earliest stages. But when this acute stage has passed, the chronic perinephritic abscess differs markedly in its characteristics from chronic pyelonephritis.

Perinephritic Abscess.—Suppurative perinephritis is usually the result of staphylococcus or streptococcus infection. It results from injury or from any form of staphylococcus or streptococcus septicemia. It is usually due to skin infection.

The acute attack begins precisely as an acute renal infection, but often no pus appears in the urine, the function of the affected kidney is not notably impaired, and the infecting organism may or may not be retrieved by culture from the urine of the infected kidney. Chills are common, *renal tenderness and later muscular rigidity* the distinguishing signs. The kidney is likely to be large, and may well be painful as well as tender. Respiration and muscular movements are likely to increase it rather more than is the case with a similar tenderness within the kidney.

If not promptly drained, the patient may die of sepsis, the abscess may become chronic or spontaneous recovery may possibly occur by rupture of the abscess through the skin or into one of the neighboring viscera, or even by resorption of the pus. In view of the safety of surgical treatment, however, it would be madness to delay drainage in the hope of any such happy issue.

Chronic perinephritis doubtless always begins acutely; but the acute attack may be so mild as to be overlooked. It may run a silent, relatively afebrile type characterized by an increasing mass in the loin which is often not very tender, and the outlines of which are relatively vague.

More commonly the course of the suppuration is marked by a picket-fence temperature, the patient is gravely septic; but even then he may make no complaint of his loin, and the urine may be free of pus.

Chronic perinephritic abscess may be quite definitely distinguished from intrarenal suppuration, though if the suppuration is advanced and the history obscure, it may be quite impossible to tell whether the pus originated within the kidney or from some other retroperitoneal source. The fully developed perinephritic abscess is fixed rather than movable, diffused rather than clear-cut in its outline, associated with relatively marked rigidity and even edema of the overlying parietes.

SYMPTOMS OF CERTAIN CLINICAL TYPES OF RENAL INFECTION

Although the pathological and clinical picture already described covers the various types of renal infection whether acute or chronic, whether occurring in infancy or in pregnancy, whether due to urethral or ureteral retention, nevertheless certain clinical types of renal infection exhibit certain dominant characteristics which merit notice. We may enumerate:

Renal infection in infancy
Renal infection in pregancy
Urethral or ureteral chill (p. 137)
Renal infection following surgical operation
Renal infection due to typhoid fever
Renal infection due to the gonococcus

Renal Infection in Infancy.—Renal infections are extremely common in infants under two years of age. They are said to be ten times more frequent in girls than in boys. The acute onset may be so mild as to be overlooked, though usually it is very stormy. Thus we may describe the acute and the chronic type of infection.

Acute renal infection in infancy, usually spoken of as the pyelitis of infancy, is usually a stormy attack with chills and high fever, tenderness in the loin, rigidity of the overlying muscles, enlargement of the kidney. These local signs have to be sought for, for the infant does not localize its pain. The debility of the patient is relatively slight as compared with the fever. It is said that malaria and acute renal infection are the usual causes of septic fever with repeated chills in infants.

Though the attack is often very acute, it rarely requires surgical treatment. The patients ultimately recover, or pass into the chronic type of renal infection.

Chronic renal infection in infants is a toxemia of the mild digestive type. There may be no fever; there may, from time to time, be acute attacks of infection. The kidney is not likely to be tender. The diagnosis depends upon the examination of a specimen of urine obtained by catheter.[4]

Townsend has called attention to the fact that chronic perinephritis occurs in children causing lameness and muscular rigidity as its most striking symptom, and is usually mistaken for spondylitis or hip disease, or even for psoas abscess. The diagnosis is often made only by operation.

Renal Infection in Pregnancy.—We have as yet no adequate data to help us determine what proportion of renal infections occurring during pregnancy is derived from latent infections of childhood.

The infection may be bilateral, but the acute infection is almost always in

[4] The cruelty of catheterizing an infant may often be avoided by the very simple expedient of letting the infant wear a pad of absorbent cotton and squeeze the urine out of this.

the right kidney. The chronic infection is almost always mistaken for toxic albuminuria from which it can only be distinguished by the examination of a specimen obtained by catheter from the bladder.

Acute renal infection occurs on the right side, is more frequent in primiparæ than in multiparæ. It may occur as early as the third month, but is most common from the seventh to the tenth.

The prognosis of the attack depends almost entirely upon the treatment. Early and appropriate treatment should save the child from premature delivery, the mother from operation.

Renal Infection Due to Retention.—Renal infection is, as we have previously said, usually due to some type of retention. This retention is, in many instances, slight and intermittent. It may be not sufficient to cause gross retention of urine in the renal pelvis, but only an acute infection of the pelvis and kidney. Under such circumstances the dilatation of the kidney pelvis from retention is a very slow process.

But in the type of renal infection of which we are now speaking, the dilatation, due to gross retention, is the predominant feature. The retention may be urethral or ureteral. If urethral, the retention is felt in both kidneys. But a secondary kinking of the dilated ureter may cause an additional retention in one kidney as compared to the other. Thus in urethral cases we may see pyonephrosis of one side, and pyelonephritis of the other.

The retention may come on gradually, or suddenly, the infection may precede the retention, and be lighted up by this, or the retention may exist for some time before infection occurs.

The most interesting type of retention infection is that due to catheterization for the relief of prostatic retention. Such retention, if chronic, may be considerable, and yet may have accumulated so gradually that, previous to the interference of catheterization, the balance of forces may have been so even that the kidneys, as tested by phenolsulphonephthalein, may be working quite well. But the passage of the catheter upsets the balance, excites an acute congestion of the kidney, and prepares the way for the infection that is soon to follow. The mechanism of this infection has been illustrated in Chapters XI and XIII. The kidneys become acutely infected, the output of solids falls, the temperature rises, pus and bacteria appear in the urine. The patient goes into a condition of urinary sepsis more or less grave in proportion to the renal destruction that had preceded infection and the intelligence of the subsequent treatment.

Renal Infection Following Surgical Operations.—Renal infection is likely to complicate the convalescence from surgical operation under three circumstances:

1. The patient has an unsuspected cause of urinary retention, usually prostatism. The acute retention following operation calls attention to this condition for the first time, and starts him on the active symptoms of prostatism.

2. Without any such preëxisting or predisposing cause of retention, the

patient's calls to urinate are neglected in two ways. In the first place, while retention is still complete the house staff neglect to pass the catheter as often as is required to keep the patient comfortable. In the second place, when the patient begins to urinate he does not fully empty the bladder, but he is then considered safe from any complications, and no further attention is paid to the bladder retention until infection supervenes.

3. The operation itself may have been a cause of retention or infection. The most annoying type of this condition is that type following the Wertheim operation with stripping of the pelvic ureter for a considerable distance. This results in ureteral atony, dilatation and infection.

It will be noted that each one of these types of retention is due to a neglect on the part of the house staff to appreciate the actual condition present. If a patient has to be catheterized but once or twice after operation, no harm is likely to result. But if continued catheterization is necessary, the case should be looked upon as quite comparable to one of prostatism, and treated accordingly.

Renal Infection in Typhoid.—In the third to the fifth week of typhoid fever, at least one case in three shows typhoid bacilli in the urine. The infection is usually symptomless, mild, and readily controlled by hexamethylenamin. Indeed as a rule it amounts to little more than a bacteriuria without symptoms. But even these mild cases may continue as latent infections for a number of years, and then develop evidences of more severe or even acute infection. Indeed, typhoid infection acts as a mild type of colon infection with the same possibility of acute or grave complications. Yet these patients are usually more dangerous to others as typhoid carriers than they are to themselves.

Renal Infection Due to Gonorrhea.—Pyelonephritis is not an unusual accompaniment of a severe gonorrhea, but the renal infection is very rarely due to the gonococcus. The cases I have seen have all but one been due to the staphylococcus or *Bacillus coli,* usually the former.

True gonococcus infection of the kidney is usually mild, but may be tenacious. It seems to be especially amenable to treatment by pelvic lavage.

CHAPTER XVI

DIAGNOSIS OF RENAL INFECTIONS

The diagnosis of renal infection presents no great difficulties. That it is so often overlooked is due to the fact that the idea of infection never entered the physician's mind.

The important point, therefore, is when to suspect the existence of renal infection. Perhaps the injunction, "always to be suspicious," would best cover the ground. But one may be more specific, as follows:

Suspect renal infection:

When a child has chills and fever, or chronic indigestion with slight fever with pus in the urine.

When a pregnant woman has fever or albuminuria, either during her pregnancy, or during the puerperium.

When an adult has an obscure sepsis, especially if due to furunculosis or if associated with a dry tongue, pyuria or frequent urination.

When a patient with indigestion complains of a dry tongue.

When a patient has frequent and painful urination, and pus in the urine, remember that the diagnosis of cystitis is meaningless unless its cause is known, and that the cause of "idiopathic" inflammation of the bladder is usually inflammation of the renal pelvis.

Under such circumstances the diagnosis of renal infection is made by clinical examination, urinalysis and cystoscopy and the ureter catheterization.

PHYSICAL EXAMINATION

The examination consists chiefly in the ballottement and palpation of the two kidneys as described on page 3. The experienced observer will readily distinguish by palpation between enlargement in the kidney itself, and the less movable, less well-defined, more edematous and boggy enlargement due to perinephritic abscess.

But palpation cannot usually tell us the precise nature of an enlargement of the kidney. Not only may there be pyelonephritis without enlargement, but it may often be impossible to palpate the difference between hydronephrosis, pyonephrosis, compensatory hypertrophy, and neoplasm.

Moreover, a tender kidney is not necessarily an acutely inflamed kidney. A kidney which is the seat of compensatory hypertrophy is often not only painful, but also quite tender.

Complete diagnosis requires urinalysis, radiogram, ureter catheter, urogram.

URINALYSIS

It will be remembered that an apparently normal urine may be obtained by catheter under two conditions:

1. When there is a septic infarct in the parenchyma, threatening to break into the perinephritic tissue, but not communicating with the pelvis, the urine from that kidney may be entirely normal, and its function unimpaired, although the kidney itself is tender.

2. Latent *Bacillus coli* infection may show no evidence of its presence except the fact that the bacillus may be cultured from the apparently normal urine.

Albumin may be equally absent in cases such as are described above, and even in cases of slightly greater severity. But with the one acute exception noted, any infection of the kidney pelvis worthy of the name includes infection of the parenchyma, and causes albuminuria. Albumin, pus and bacteria form the characteristic combination. The absence of casts is rather the rule than the exception in surgical nephritis.

Thus simple urinalysis goes rather further than simple palpation, and usually tells us that there is, or is not, renal infection.

THE COMPLETE DIAGNOSIS

A complete diagnosis of renal infection discerns the presence of infection, the infecting organism or organisms, the source of these organisms, the accessory causes of infection, the renal function, the gross changes in kidney and ureter as shown by urogram, the presence of stone, cystitis, prostatitis, related conditions such as tuberculosis or tumor, and above all the patient's general condition.

Such diagnosis implies the use of cystoscope, ureter catheter, phenolsulphonephthalein, radiogram, urogram, etc. The experienced clinician will, however, defer this complete examination whenever it seems probable that the trauma of instrumentation may aggravate the infection or not offer adequate promise of reward, or when the clinical course of the infection itself promises spontaneous recovery. Thus infantile and post-typhoid infections may habitually be cured without cystoscopic diagnosis and pyelonephritis secondary to urethral stricture retention does not invite cystoscopy. Yet, even these may peremptorily require a complete diagnosis by their gravity, their acuteness or their chronicity. The urologist may properly incline to radical diagnosis, the internist to conservatism.

Septic Infarcts and Perinephritis.—The diagnosis of septic infarcts and of the subsequent perinephritis is possible only after the clinician has learned to appreciate that the infarct is often so localized in the kidney as to cause little tension upon the capsule and consequently little pain. When there is infection of unknown origin he must seek by palpation the tender kidney, which may be its source. Urinalysis and the routine renal function tests and urography will

not help. The combination, infection, a tender kidney, a normal urine, means septic infarct. I have but once mistaken a lumbago for infarct.

Perinephritis is equally elusive to the routine urological examination. Even if the perinephritis abscess is associated with pyelonephritis the investigation of the inside of the urinary tract does not tell what is going on outside it. The brunt of the diagnosis falls upon palpation of the loin by the simultaneous bimanual method (Chap. I) and simple radiography. The former is the only means of disclosing the elusive fullness and rigidity of the loin. The radiogram must be good enough to show the obliteration of kidney outline and of the edge of the psoas, or to disclose restriction of the motions of the diaphragm.

As soon as the urologist is satisfied that there is infection with persistent tenderness, rigidity and vague fullness of one loin, he should operate.

Acute Pyelonephritis.—Persistent pyuria and albuminuria prove the existence of renal infection. The temperature marks its acuteness. The infection should be looked upon as bilateral until the ureter catheter proves it unilateral. The more acutely inflamed kidney is usually tender, often large.

No two urologists will agree precisely as to the ideal moment for ureter catheterization. The question is rather a therapeutic than a diagnostic one. If there is ureteral retention, ureter catheter drainage may cut short the attack. If there is already a considerable acute parenchymatous suppuration, ureteral chill would considerably aggravate this. If the prostate is infected, cystoscopy may excite acute prostatitis. Whatever the urologist's attitude we may ask that at least he do not think that every acute renal infection is due to ureter stricture or hasten to cure them all immediately by ureter catheter drainage.

Chronic Pyelonephritis.—Chronic pyelonephritis is readily diagnosed as such; but this diagnosis has no value until it extends to cover stone and tuberculosis (*q.v.*). As I write these lines, the last kidney operation I have performed was a bilateral simultaneous nephrotomy to save the life of a woman whose intense sepsis was the result of six months of ureter dilatation for stricture. Her radiograms were repeatedly negative. I saw her first utterly worn out, passing from each kidney a stinking brown mud. Drainage revealed phosphatic stone in both kidney pelves. I did not stop to complete the diagnosis by urogram.

But such cases are rare. As a rule one peacefully makes a complete diagnosis covering the site of infection, renal function, contour of ureter and pelvis, situation and character of ureteral obstruction, presence or absence of prostatitis, stone, tubercle.

The differential diagnosis between pyelonephritis and prostatitis is not the easiest thing in the world. The two often coexist and the diagnostician who picks on the wrong one as the more important will not cure his patient. Quite recently I fiddled a month with an acute influenzal prostatitis before turning it over to Jeck, who cured it in two days with hexamethylenamin, save the unimportant silent catarrh of the prostate. Quite frequently I see in consultation patients with both organs inflamed, who have been vainly treated by medication

Plate VIII.—Urograms of Chronic Renal Infection.

Fig. 1.—Chronic pyelonephritis. The pelvis is very slightly dilated. The calices are distinctly blunted. There is no ureteral obstruction.

Fig. 2.—Pyonephrosis, ureter stricture. Kidney low, ureter dilated, elongated and kinked above stricture. Its contents do not empty in ten minutes. Pelvis so greatly dilated as to obliterate calices and thin parenchyma to a shell.

Fig. 3.—Pyonephrosis secondary to hydronephrosis. The low kidney occasioned a kink at insertion of ureter into kidney pelvis. The resulting hydronephrosis became inflamed, the kink fixed, the kidney pelvis ballooned out below the ureteral orifice, graver infection superversed resulting in stricture at the upper end of the ureter and pyonephrosis.

Fig. 4.—Chronic pyelonephritis. The calices are much dilated, the pelvis not dilated. Most authorities would interpret the ureter as not dilated though it is definitely relaxed and the kidney low. The urogram suggests stricture but the absence of retention was proved at the moment of introducing the ureter catheter and also by the fact that the injected fluid was emptied out within five minutes.

Fig. 5.—Pyonephrosis of the megalo-ureter type, ureter stricture. The ureteral constriction seems due to external bands. All channels above are widely dilated and infected.

Fig. 6.—Septic infarct, perinephritic abscess. The infarct has burst both ways. There is pyelonephritis with blunting of most of the calices. The injected fluid passes through the fistula in the lower pole of the kidney into the perirenal fascia.

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for months and yet need only a few massages of the prostate and vesicles with a whispered word of advice on sex to cure them.

Pyonephrosis.—The gross diagnosis is easy. The toxic symptoms, with or without fever, suggest it. The thick pus and the ureter catheter findings prove it. The mass in the loin confirms it. So does the radiogram (Plate VIII). If acute, we may spend a few days in attempting ureter catheter drainage while we study out the diagnosis as to stone and tubercle. If a month old, we operate by way of biopsy on condition that the opposite kidney is adequate.

CHAPTER XVII

TREATMENT OF RENAL INFECTIONS

The principles of the treatment of renal infection are deducible from the general surgical principles involved. The infected kidney is a suppurating cavity, usually a badly drained cavity. Consequently the first and foremost indication is to establish good drainage whether for prophylaxis or for cure, whether by posture, by ureteral or urethral catheter, or by surgery.

The second indication is antisepsis. We must prevent the infection reaching the kidney from bowel, bladder, furuncle, tooth, tonsil, etc. Once the kidney is infected, we ply the patient with hexamethylenamin and perhaps add pelvic lavage by way of local antisepsis. We modify the acidity of the urine and its dilution in order to make it as unfit as possible a medium for the growth of the offending organism.

PROPHYLAXIS

One should be on the lookout for infection of the kidney whenever a patient suffers from constipation, typhoid fever, retention of urine, furunculosis, or any form of sepsis. The prevention of infection from such sources generally means simply the elimination as rapidly as possible of the source of infection. But certain types of prophylaxis require special insistence, as follows:

Prevention of Urethral and Ureteral Chill.—Urethral chill is a possible complication of every passage of an instrument into the urethra. It is probable if retention requires a retained catheter or repeated instrumentation. The prevention of infection by gentleness during manipulation, by 1 gram of hexamethylenamin, three times a day, beforehand, and an instillation of 1:1,000 acriflavin, following the instrumentation, suffices when there is no retention. Chronic retention, whether due to prostatism, bladder paralysis, diverticulitis, etc., requires the same gentleness and appropriate bladder drainage.

But if gentleness is neglected by the average practitioner when passing an instrument into the urethra, what shall we say of the ureter catheter brutalities we see some of our most prominent urologists practice? Fortunately for the patient, brutality with the indirect vision cystoscope does not pay. It merely results in failure to get up the ureter. But the direct vision scope puts in our hands an instrument that will drive a catheter past a snug internal meatus of the ureter and the operator will never feel the ureteral chill that follows.

Prevention of Infection from the Upper Air Passages.—Rosenow, Hunner, and those others who have an eye to metastatic infections of the urinary

organs, remind us to attribute much of the renal and prostatic infection that we see to coryza, sinusitis, influenza, tonsillitis, etc. Whether we believe in the full sweep of their theories or not, it is our duty as practitioners to see that our patients' sinus headaches are relieved, their teeth cared for, their tonsils suspected.

Prevention of Infection by Posture.—Since the so-called spontaneous infections, notably those of infants and young women, are apparently due to renal mobility, these may, except in the case of infants, be prevented by training in proper posture. The patient should spend at least an hour every day in exercises calculated to expand the lower chest, by throwing the shoulders back, the chest out, the hips in, the abdomen in and the toes in. In addition to this, the patient should be encouraged to lie flat on her back with no pillow under the head, and a small pillow under the lower chest, below the shoulder blades.

TREATMENT OF ACUTE RENAL INFECTIONS

Mild Cases.—Infection of a well-drained kidney, even when so severe as to cause chill, recovers spontaneously without treatment. But if the attack of fever lasts long enough to bring the patient under the physician's observation, he should be put to bed at once, kept upon his back, preferably with no pillow under his head, and with a small pillow under the lower ribs, so as to widen the lumbar recess. After a single purging a colon irrigation once or twice a day will encourage diuresis, and minimize absorption from the bowel. The patient's ears, mouth, abdomen and genitals, both internal and external, should be carefully investigated for possible sources of infection.

The medical treatment usually employed consists in the administration of large quantities of water, and of hexamethylenamin. Hexamethylenamin often does no good for, like other solids, it is not excreted in any quantity by the acutely inflamed kidney, and the water dilutes it beyond the limits of efficiency. If the fever is not above 100°, try hexamethylenamin in doses as high as the patient can stand and without diuresis. If there is high fever, give 2,000 to 3,000 c.c. of water a day without hexamethylenamin.

The administration of large doses of alkali has been employed empirically with some success in the treatment of the acute renal infections of children. Potassium acetate or citrate may be given in doses as high as 1 gram, three or four times a day, even to children six or eight years of age. For infants the alkali may be mingled with the colon irrigation fluid, 1 gram being given twice a day. The alkaline treatment has not proven particularly successful for adults.

For at least a week after the patient is out of bed his temperature should be closely watched as moving about may cause a relapse of the fever, and require a renewed stay in bed.

Severe Cases.—Septic infarcts require immediate decapsulation and drainage.

Acute bilateral suppurative pyelonephritis, or the same lesion in a single

kidney requires the same treatment if the patient shows rapid progress of the toxic symptoms and mounting blood retention. One is rarely called upon to make this decision; it must be made on clinical instinct alone; it is only justified when one is confident that within a few hours or days the patient will die of renal insufficiency. This decision when properly made and executed saves a life that would otherwise be lost.

On Christmas Day, 1925, I removed the kidney illustrated in Figure 50. The patient had suffered rather severe pyelonephritis during her first pregnancy, but got by. She was again pregnant three months. The day I first saw her she had seven chills. The following day I removed the right kidney after satisfying myself that there was a left kidney by exploring the loin, as I did not know how to catheterize the ureter. She recovered, but miscarried, bore several children thereafter, and evidently had a mild chronic pyelonephritis in the remaining kidney. Indeed, for several years she had occasional digestive or mild febrile attacks from this. But she remained on the whole very well until in 1927 she undertook against medical advice a reduction cure that included constant purging. As a result she came down with an irregular fever, tenderness in the left kidney, and grave toxemia, vomiting and was delirious at times. The ureter catheter revealed no obstruction, no retention. I concluded there was a small perinephritic abscess. The loin was a little rigid, the blood chemistry slightly elevated, the phthalein output reduced to about one-half the normal. On the third day she became quite irrational. Under ethylene I made a small incision in the loin, broke through adherent edematous fat to reach the kidney, where to my surprise I found no perinephritic abscess but, without seeing the kidney, since she is not lean, I found the capsule so adherent to the fat and so fragile that my finger tore through it. I could feel a swollen region of localized miliary suppuration, so I stripped the capsule back without seeing the kidney and left a drainage tube in the loin. The following day she was substantially well but without memory of the events of the day before. She has had no attacks in the year following the operation. She rides horseback daily.

This case illustrates the indications for decapsulation. Nephrectomy has been so much overdone that some surgeons deny that it is ever to be advised for the treatment of acute renal suppuration. It is possible that the kidney removed in 1905 might have been saved. Decapsulation should be the first thought, even in the most desperate cases. Yet it may be set down as a good rule that the sicker the patient the more one should incline to nephrectomy. The usual indication for decapsulation is persistence of fever at 104° or over for several days, in the absence of ureteral retention.

But most cases of acute pyelonephritis are directly related to retention; *e.g.*, the case cited, due to pregnancy. If the retention is urethral the temperature will often take several days to subside after the relief of this condition. If ureteral, the chief aim of treatment is to relieve constriction by dilatation, kinks by position or by operation.

Irrigation of the kidney pelvis is of value chiefly for the dilution of thick

pus in a dilated kidney pelvis. The injection into the kidney pelvis of strong solutions, such as 1 per cent silver nitrate, has no place in the treatment of acute renal infections. Generally speaking, what is needed is drainage and not antisepsis. Not infrequently the passage of a ureter catheter for diagnosis, though it may detect no obstruction and reveal no retention, irons out some slight ureteral obstruction and relieves the infection. It is not fair to follow these patients as candidates for dilatation of ureter stricture. When their fever, pus and bacteria disappear they should be let alone. If these do not disappear they should be treated as cases of chronic pyelonephritis.

TREATMENT OF CHRONIC RENAL INFECTIONS WITHOUT RETENTION OR SEPSIS

Here is a class of cases characterized by few subjective symptoms other than constipation, frequent urination, discomfort in the back—indeed often quite asymptomatic. But the urine contains pus, bacteria and at least a trace of albumin.

Such patients are often calm enough as to their prospects, yet the physician must look into the future. He must not only treat the present symptoms but also anticipate the ultimate prospect of grave damage to the renal parenchyma. This he may do in terms of (1) damage already incurred, (2) retention, and (3) intercurrent infection.

Damage Already Incurred.—The cases under consideration may be divided into two classes, viz., those that have and those that have not been permanently damaged by such agencies as stone, operation or retention. With the relief of these the renal infection often heals spontaneously. But if it does not, *e.g.*, if following prostatectomy the phenolsulphonephthalein test shows fixed loss of renal function, with pus, albumin and bacteria, no treatment should be undertaken as long as the kidney pelvis empties itself, except such treatment as is comprised in diet, hygiene and regulation of the bowels, coupled with accuracy in the diagnosis of the absence of stone and retention. As I write these lines I have in hand a letter received this morning from a patient who consulted me ten years ago, suffering from renal colics, chills and fever. The left kidney had been removed for stone. The right was much dilated, its parenchyma thinned, its phthalein output 32 per cent, its urea concentration 1 per cent. I removed a round stone 2 cm. in diameter from the kidney pelvis. He remained on a low protein diet and several months later went to Europe, apparently well.

In the ensuing ten years he has taken no treatment. He writes that he is well and declares he has a system for beating the bank at Monte Carlo. I am sure no treatment of mine would have left him healthier or happier.

It is in precisely this class of cases that one has the greatest difficulty in deciding whether to employ ureteral dilatation. Perhaps we may at present safely classify them as follows: if the patient's symptoms are nil, the renal function good, and the infection approximates a bacteriuria, one may safely pro-

crastinate in the hope that the case will do well without local treatment of the kidney pelvis and ureter. Cases that do not fulfill these conditions should be submitted to a complete diagnosis with pyelogram and wax bulb, and treated by dilatation of the ureter and pelvic lavage.

Retention.—To be sure, we are discussing renal infection without retention or sepsis. Yet the precise elimination of minor ureteral retention, permanent or intermittent, by ureteral kink or stricture is one of the problems of urology not yet fully solved. The studies of Hunner, discussed in Chapter XVIII, on ureteral stricture have posed a question without wholly answering it. Ureteral obstruction should be thought of as the accessory cause of every chronic pyelonephritis. If none is found and the infection does not yield to the measures detailed in the ensuing paragraph it may be disregarded. Observation from time to time will show that the renal function holds its own. Such patients may be expected to live to a green old age. The mild renal infection harms them no more than would a similar catarrh of any other mucous membrane. Ten years ago I was able to say that I knew three patients with chronic pyelonephritis whose infection antedated my birth. They are all dead now, in their seventies and eighties.

Hygiene.—Such patients should be meticulous in the care of the bowels. Constipation threatens the kidneys with a deluge of colon bacilli. They should drink freely of water to keep the specific gravity of the urine below 1015. They need restrict their intake of alcohol and proteins only to the extent that the established impairment of renal function requires. They should feel well; their blood chemistry should keep low.

Prophylaxis.—Such kidneys are peculiarly liable to damage by intercurrent infections elsewhere in the body, such as colitis, tonsillitis, influenza, pneumonia, etc. Hence the seeming anomaly of a streptococcic throat exciting a latent *Bacillus coli* pyelitis. Such patients require careful investigation for metastatic foci.

Pelvic Lavage.—The pelvis of the kidney may be washed out through a ureter catheter, once or twice a week. The most valuable solution for this purpose is silver nitrate in strength of from 0.5 to 1 per cent. Not more than 2 c.c. should be injected, and this should be permitted to run out through the ureter catheter.

Pelvic lavage should not be employed in acute cases, in cases with retention of urine, in cases with definite impairment of the function of the kidney as estimated by the phenolsulphonephthalein output. Under favorable circumstances, it is even claimed, by Geraghty, that favorable cases may be actually cured even of a *Bacillus coli* infection by this lavage. Their active symptoms may certainly be relieved.

Vaccines.—Vaccines, whether autogenous or stock, are of no value.

Summary.—As an actual fact the great majority of the mild cases of renal infection, without sepsis or grave retention, do not even come for treatment. They consider themselves practically well. And the most mildly infected suffer

so little, and are offered so little prospect of help by any treatment that one can scarcely blame them for shirking. Some carry their mild pyelitis for many years before their renal parenchyma succumbs. But they should be urged to submit at least to a complete diagnosis, and, if ureteral obstruction is found, encouraged to submit to treatment.

TREATMENT OF PYELONEPHRITIS DUE TO RETENTION OR CAUSING SEPSIS

The ideal treatment of pyelonephritis due to ureteral or urethral retention is relief of this retention by posture, dilatation or operation. If the kidney is pyonephrotic or so dilated as to have lost all function, nephrectomy is indicated.

The following observations may prove suggestive in the treatment of such cases.

In Children.—The pyelonephritis of childhood is no different from that of the adult. The child is subject to retention, stone, tuberculosis and the diagnosis and treatment of these forms, the most important element in the treatment of the renal infection. It is to be noted, however, that the child, less immune to infection than the adult, is often relieved by a single ureter catheterization. Posture and tonsillectomy should always be considered in the treatment of the renal infections of children.

In Pregnancy.—The element most essential to the success of treatment for the pyelonephritis of pregnancy is promptness. Cragin's formula, "Give hexamethylenamin first and examine the urine afterward," as the treatment for fever during pregnancy is still sound. Prompt urinary antisepsis will control most cases. If the fever continues unabated the treatment becomes more difficult, for some one must be found who will catheterize the ureters gently. One rough push and the ureter thereafter will close—the kidney, perhaps the patient, be lost. The catheter is left in long enough to drain off the retained urine and, if the last few drops are thick, the kidney pelvis should be irrigated with some unirritating solution.

If fever is only temporarily relieved this maneuver may be repeated every day or so on condition that a small catheter, not over 6 F., be used. The use of the indwelling catheter should be deferred as long as possible.

The indwelling ureter catheter is the subject of furious discussion. Albaran used them twenty years ago and had a double length filiform whereby he withdrew and replaced the catheter every four days without introducing a cystoscope, and Guyon used to say that the ureter catheter caused the patient less inconvenience than the urethral catheter. We have learned that the "x-ray" catheter wears better than the other kind. But most of the really important questions in relation to the indwelling ureter catheter are not answered. Should we use large (12 F.), or small (6 F.) catheters or filiforms? It is difficult to keep the catheter open and perhaps capillary drainage alongside it is just as satisfactory. No one has carefully studied the ultimate results of this treatment. Does

it leave scars that will result in stricture? We do not know. To-day the tendency is to use the indwelling catheter quite freely.

But the indwelling catheter itself is no more than a temporizing expedient. It may carry the case over an emergency lasting from two to six weeks but if spontaneous drainage is not reëstablished the kidney will have to be drained by operation. This possibility should be kept in mind when intermittent drainage does not suffice to control the situation.

Slight Ureteral Retention.—Of pyelitis in general it may be repeated that chronicity must be attributed to retention when stone and tuberculosis can be eliminated, and even these specific causes of retention act largely by virtue of the retention they occasion. A patient of mine died three months after prostatectomy of sepsis resulting from retention in one calix. Much more common are those cases of slight ureteral retention, readily relieved by the single passage of the catheter. Misinterpreted by one generation of urologists they formed the excuse for an enthusiasm for pelvic lavage now replaced by an ardor for ureter dilatation. I have seen total anuria result from impaction of urate crystals. I have seen acute pyonephrosis result from inspissated pus. Operative relief in each case required no ureter dilatation and yet the cures persisted at least ten years. The case of acute pyelonephritis cited above has no ureter stricture. These slight ureter retentions are not well understood. Some of them are extrinsic, due to ureter kink from mobility or adhesions. Some are intrinsic, due to crystals, areas of ureteritis, etc., especially at the points of natural constriction toward the lower end of the ureter. Perhaps we may even learn to consider ureter meatotomy as routine an operation as we now do urethral meatotomy. But at present we only know that renal infection is excited and kept up by ureteral obstructions so slight that they offer no perceptible resistance to the catheter that overcomes them.

What is still worse, we do not know how widely a ureteral "stricture" must be dilated in order to overcome the obstruction and relieve the infection. In this class of cases there is no appreciable renal retention to guide us. We must go by the symptoms. Hunner maintains that the ureter must be dilated sometimes as high as 16 F. or even higher. Most cases are relieved by far less dilatation. It is my present practice to dilate only as far as necessary to relieve infection, regardless of the hang of a ureter catheter bulb at some point in the course of the ureter.

Hunner has opened a new field of diagnosis and treatment by his studies of ureter stricture. Thanks to him we no longer accept chronic renal infection as incurable until systematic ureter dilatation has been employed. But it is not clear that his definition of stricture will stand.

A few of those cases that are not relieved of their ureteral obstruction by dilatation may be relieved by operative exploration of the kidney, nephropexy with freeing of ureter kinks, forced dilatation of the ureter from above. If these means fail, nephrectomy may have to be resorted to.

Again there are cases that seem not to merit any strenuous effort to cure

their pyelonephritis. If the infection does not progressively impair the renal function or its treatment seems to make them worse, it is often wiser to let well alone and not to risk a life by operation.

Braasch's contention that dilatation and infection of the ureter and kidney pelvis are not always the result of obstruction seems justified. The dilatation may be atonic and the result, not the cause of the infection. In such cases ureteral dilatation is vain.

It is noteworthy that Hunner, who has had more experience with the treatment of renal infections by palliative means than any one else, has given up pelvic lavage except for the purpose of cleaning the pelvis of the kidney of thick pus.

Urethral Retention.—The renal infections dependent upon urethral retention were the first to attract the attention of surgeons and are relatively common. The relief of the urethral obstacle is evidently essential to the cure of the renal infection. But if the case is of long standing secondary kinks and obstructions by scar within the ureter may require attention. Yet such cases are often too old and infirm to undergo much treatment for the relief of ureteral obstruction, unless by nephrectomy for pyonephrosis.

TREATMENT OF URINARY SEPTICEMIA

Prevention, relief of retention, diuresis, antisepsis and those measures calculated to combat other forms of septicemia are the basis of treatment.

The prevention of septicemia rests chiefly upon the relief of retention, notably prostatic or ureteral, as elsewhere described. Radical cure depends also chiefly upon the relief of retention. Diuresis palliates the sepsis that cannot be relieved.

Antisepsis by hexamethylenamin or hexylresorcinol is without value and although antisepsis by intravenous medication with mercurochrome, acriflavin, etc., has been stoutly supported by many favorable reports, the results of such treatment have not been sufficiently favorable to encourage the hope that the ideal blood stream antiseptic has been found. Young is still an ardent advocate of mercurochrome, though he has given up the notion that it acts as an antiseptic when given intravenously.

If the sepsis is due to absorption from one kidney whose retention cannot be relieved and whose fellow is substantially sound, nephrectomy is the solution. If the opposite kidney is not capable of supporting life, drainage by pyelotomy or nephrotomy may palliate the situation until adequate drainage can be supplied.

Vaccines have not helped.

TREATMENT OF PYONEPHROSIS

The treatment of pyonephrosis not due to stone or tuberculosis depends upon several factors. Acute pyonephrosis that has existed but for a few

weeks is usually due to the fact that the renal pus is so thick and viscous that it blocks the ureter. Nephrotomy, a single irrigation of the renal pelvis with sterile water, and drainage for a week by a tube in the loin will save the kidney, unless there is considerable ureteral or urethral obstruction. I have twice relieved this condition by ureter catheter without operation.

Chronic pyonephrosis requires nephrectomy if the opposite kidney will support life, permanent nephrotomy if it will not.

A "one-stage" nephrectomy is preferable to drainage followed by nephrectomy and the accomplished surgeon will usually find primary nephrectomy easier to perform and safer for the patient than secondary nephrectomy.

CHAPTER XVIII

URETERITIS AND URETER STRICTURE

The ureter is the excretory duct of the kidney. It is a fibromuscular tube beginning at the funnel-shaped neck of the renal pelvis and terminating at the lateral angle of the trigone of the bladder. There is normally one ureter for each kidney, though the non-union of the two major calices of the kidney until they have passed some distance beyond the hilum of the kidney, is so common a deformity as to be not far from the normal. The ureter is, when empty, a closed tube like the urethra. It measures 25 to 30 cm. long post-mortem but its length as measured by the ureter catheter is very close to 25 cm. in the adult.

The ureteral tube may be considered as beginning with a cone attached to the apex of the kidney pelvis leading to a constriction 1 or 2 cm. below the pelvis. This constriction is at the point where the ureter leaves its attachment to the posterior surface of the peritoneum. Its normal diameter is about 5 mm. Below this point the ureter dilates to a diameter of 10 mm. or more and then recontracts to about 7 or 8 mm. at the angle where it dips into the true pelvis, bending over the common iliac artery at its point of bifurcation. A second dilatation or spindle of the tube then begins and the caliber of the ureter in the bony pelvis nearly reaches 11 or 12 mm., at the lower end of which and about 5 cm. from the bladder orifice of the ureter begins the juxtavesical constriction, first described by Schewkunenko.[1]

Schewkunenko describes this constriction as being the narrowest point of the ureter excepting the ureteral orifice itself. Schreiber believes that it is rather a tapering point of the relatively wide ureter above to the relatively narrow, 5 to 8 mm., caliber of the ureter as it passes through the bladder wall. This terminal intramural portion of the canal is about 2 cm. long, very slightly spindle-shaped and terminates in an orifice in the vesical mucosa which is as little fixed in size as is the orifice of the urethra, but which normally should be at least 5 mm. in diameter.

To summarize, the ureter is a tube 25 cm. long of which 10 cm. consist of the abdominal spindle with its 1 or 2 cm. juxtarenal funnel. The remaining 15 cm. form the pelvic spindle, 10 cm. in length with a slight constriction at the pelvic brim and a funnel-shaped constriction 5 cm. in length at the lower extremity, the last 2 cm. of which represent the passage of the ureter obliquely through the muscle of the bladder wall.

The renal and the iliac constrictions are quite variable and may seemingly

[1] *Cf.* Schreiber, *Surg., Gynec. & Obst.*, 1927, xlv, 423.

be entirely absent. The funnel-shaped constriction at the lower end of the ureter is quite constant and is habitually tighter than any other part of the ureter, while the adventitious constrictions arising from inflammation or kinking at the point where the ureter is crossed by the vas deferens, the uterine artery and the obliterated hypogastric artery are pathological.

In structure the ureter is composed of three coats. Between the fibrous sheath without and the mucous membrane within the muscular coat of the ureter consists of the usual external longitudinal and internal circular arrangement of the smooth muscle. The longitudinal coat is the better developed. It runs down from the calices above to form the trigone below. The muscular coat of the ureter, though distinctly developed, is thin excepting at its lower extremity. Indeed Schreiber believes that the juxtavesical constriction of the ureteral lumen is due to an increased thickness of the muscular layer. "In the juxtavesical region, the muscularis is physiologically two to five times as thick as in the pars parietalis. Furthermore, this muscularis is not only thick, but as a layer, it is found to be composed of very thick and densely packed longitudinal muscle bundles, with very dense and thick intermuscular fibrous connective tissue bundles. And lastly, the tunica propria or submucosa in this region is usually one-half again as deep as that above and is composed of denser connective tissue. It should be pointed out that in neither the mural nor juxtavesical portion of the ureter are to be seen circularly disposed smooth muscle bundles to warrant the widely accepted conception of a true ureteral sphincter."

The urine drips into the kidney pelvis from the tubules and from this point is excreted into the bladder by a peristaltic wave which, beginning in the calices has an alternative pumping between calices and pelvis (p. 79), thence extends down the ureter to the bladder. That reflux of urine does not normally occur from the bladder up the ureter is apparently due to the oblique implantation of the ureter in the bladder wall and to the constricting effect of the bladder muscle itself, for Graves has observed that when regurgitation does occur in animals, the tendency to it is at a maximum when the bladder is only partially filled.

The mucous membrane of the ureter is smooth and thrown into longitudinal folds. The epithelium consists of several superposed layers, the deeper ones conical or ovoidal, the superficial ones cuboidal or flattened. Though some expert microscopists claim to be able to distinguish the epithelium of the pelvis of the kidney from that of the ureter, most conservative observers confess their inability to make such a distinction, and do not even venture to assert that any given cells in the urine come from any part of the ureter or its pelvis unless the presumption is confirmed by other signs, notably the presence of renal casts and albumin.

The ureter lies immediately behind the peritoneum throughout almost its whole length. It is firmly attached to this structure, so that when the peritoneum is detached from the parietes the ureter is carried with it. When this dissection is performed by the finger the ureter may be identified on the smooth yielding

surface of the peritoneum within 3 cm. (1½ inches) of the spinal column, by gentle stroking which excites the peristalsis. In the abdomen the ureter lies upon the psoas muscle and crosses the genitocrural nerve. It is in turn crossed by the spermatic, or ovarian, vessels. On the right side it lies close to the vena cava. At the brim of the pelvis it crosses the common iliac vessels at their bifurcation. Thence it plunges down in a fold of peritoneum, a posterior false ligament of the bladder, passes under the arch of the vas deferens, external to it, entering the bladder wall close above the seminal vesicle and about 2 cm. from the median line. Thence it runs 2 cm. obliquely forward and inward through the bladder muscle and beneath the mucous membrane, and emerges at the angle of the trigone 3 cm. from its fellow and the same distance from the urethral orifice.

The ureter, like the appendix, cannot be felt when normal. In the female pelvis the thickened diseased ureter is felt by rectal palpation almost up to the pelvic brim. But in the male it is only in exceptional cases that tenderness or enlargement at the lower extremity of the ureter can be appreciated by rectal touch in the region just internal to the base of the seminal vesicle.

URETERITIS AND URETER STRICTURE

Inflammation of the ureter occurs in two forms; a general infection, by extension along the mucosa of a pyelonephritis, and a localized infection, in the form of stricture, kink or spasm.

The general ureteritis is an entirely unimportant lesion, a symptomless extension of infection from the kidney pelvis down toward the bladder. As such it requires no comment. But it may leave localized areas of inflammation in the ureter wall to be the seat of stricture, the cause of spasm; and these areas of chronic inflammation may extend beyond the wall of the ureter as adhesions to the surrounding tissues and thus occasion ureteral kinks.

It is these strictures, spasms and kinks that really interest us. Under the generic and somewhat misleading title of ureter stricture they are grouped in the minds of urologists as the occasion of a group of reflex, inflammatory and obstructive clinical pictures that have but one thing in common; viz., they can be relieved by the passage of instruments up the ureter.

Unfortunately though the therapy is well established the pathology of these conditions is little considered. For this reason it seems necessary to preface our definition of the three lesions to be discussed by a statement of what they most emphatically are not.

In the present state of our knowledge it might seem necessary to define ureter stricture clinically as a point of narrowing in the lumen of the ureter sufficiently rigid to catch the shoulder of a bulbous bougie that has been passed through it and to resist the withdrawal of this instrument. But this definition will not suffice since exploration of any normal ureter will reveal a narrowing at least at the juxtavesical constriction and, if the bulb is big enough, at other

points as well. These narrowings are congenital and are to be considered pathological only in the same sense as a urethral meatus is pathological when it interferes with the outflow of urine, the cure of urethritis or the passage of instruments.

Actually therefore we must add a second element to the popular definition. To be considered a stricture the condition must produce symptoms as proven by the fact that dilatation of the ureter relieves the symptoms.

In the nature of things pathological material, whether operative or post-mortem, is unavailable and unfortunately the urogram, exhibiting as it does an instantaneous photograph of a ureter overdistended in some spots and incompletely distended in others, deformed by spasm and in peristalsis, gives a very inaccurate picture of the actual pathological details. Hence we must resign ourselves for the present to list the pathological processes, to recognize that the symptom, pain, and the results of obstruction, dilatation and infection, may result from stricture, from spasm or from kink or from a combination of them and attribute individual symptoms only tentatively to one or the other lesion.

Ureteral Spasm.—Spasm may be evoked in any portion of the ureter by a local irritation. Renal colic due to stone is the pain reaction to distention of the urinary channels above the point where the ureteral spasm grasps a stone. Hence the relief of the pain by morphin or by spinal anesthesia which relieves the spasm.

But the tendency to spasm is usually manifested at points of normal constriction. In the upper ureter the urogram shows spasm at the superior constriction. In the mid-ureter, at the brim of the pelvis. In the lower ureter usually at the juxtavesical constriction, less often at the points about 2 cm. higher up where the ureter is crossed by the vas in the male, by the uterine artery in the female.

Doubtless, also, a ureter congenitally small at any of these points is especially liable to spasm and also to localized ureteritis and stricture at such unusually constricted points.

Furthermore, it is noteworthy that the lower orifice of the ureter, even of the most normal ureter, seems much more sensitive to the contact of the ureter catheter than the adjacent vesical mucosa or than the ureter more than 5 cm. above the orifice. This is doubtless the reason why most ureter spasm is encountered in the juxtavesical region. Feminine sensibility doubtless accounts for the marked predominance of spasm among women.

Hunner introduced ureteral spasm to the medical world under the title of "ureteral stricture" in the belief that the lesion is always an inflammatory one. Yet in his latest publications [2] he repeats that gross pus is found in the urine in only 20 per cent of his cases, a few leukocytes in 50 per cent more, while the urine is entirely normal in the remaining 30 per cent. This does not make a very good case for an inflammatory origin of the spasm and yet no

[2] *Surg., Gynec. & Obst.*, Nov., 1926, 615; *Am. J. M. Sc.*, 1927, clxxiii, 157.

other cause has been suggested and for the present we must think of the condition as an inflammatory one.

But Hunner goes further than this and suggests that the underlying inflammation is a metastatic one, derived usually from infection of the teeth or upper air passages. This too we may accept for lack of a better theory. At least it serves the useful purpose of reminding us that our patients should have teeth, tonsils and sinuses attended to as well as skin and bowels.

Stricture of the Ureter.—A stricture of the ureter is a chronic inflammatory infiltrate of the ureteral wall sufficiently extensive to interfere with normal peristalsis. Stricture of the ureter, like stricture of the urethra, obstructs the outflow of urine at first only by interfering with muscular action, later by actually diminishing the lumen of the canal. Pathologically it is composed of cellular infiltrate in which, as in the urethra, there may be more or less scar. Hence, like stricture of the urethra, some ureteral strictures may be relieved by dilatation; others may not.

True ureteral stricture occurs most commonly under three conditions: (1) As an ulceration at the site of impaction of ureter stone. (2) At the upper end of the ureter as the result of inflammation secondary to kinking. (3) At the lower end of the ureter from inflammations derived from adhesions to the inflamed vas deferens, from pelvic cellulitis, from impacted stones and in a small but very striking class of cases congenitally, as the cause of that great dilatation of the ureter known as megalo-ureter. Spasm at the point of stricture is not uncommon.

Ureteral Kink.—There are two kinds of ureteral kinks shown by the urogram. The one gives symptoms, the other does not. Kinks are most often seen at or near the upper end of the ureter, for here it is that the canal leaves its retroperitoneal sheath and lies free in the retroperitoneal connective tissue, here renal mobility kinks the ureter either over an aberrant artery to the lower pole or at one or other end of the mobile area, the point of junction with the renal pelvis and the point of attachment to the peritoneum.

The kink that causes symptoms has two striking urographic characteristics. It is fixed and therefore shown at the same point on all urograms. It causes dilatation and therefore the ureter above the kink is more dilated than the ureter below. Indeed the existence of any dilatation below the kink leads to the suspicion that the real obstruction is lower down.

The kink that does not cause symptoms is not a kink at all but only appears as such in the urogram. It is only a curve in the ureter that appears as a kink because of the angle at which the urogram is taken. A second urogram taken at right angles to the first will prove this. Such kinks are not fixed and show as much dilatation below the kink as above it. They are part of the real or apparent dilatation of the ureter, real if the ureter is dilated for the dilatation lengthens the tube as well as dilating it; apparent if due to renal mobility without ureteral dilatation, slackening the ureter just below the kidney.

The symptomless kink is part of the urographic picture of a dilated ureter, whether the obstruction be in the ureter below or in the urethra. It is of no clinical importance. The real kink is due to a fixed angulation of the ureter by inflammatory adhesions. Thus the kink at the pelvic orifice of the ureter is due to adhesion of the ureter to the pelvis and lower pole of the kidney combined with abnormal mobility of the kidney or abnormally high implantation of the ureter in the kidney pelvis. The kink in the mobile upper end of the ureter is due to renal mobility plus inflammatory fixation of the ureter. Whether this is primarily or secondarily over an aberrant artery or not makes little theoretical difference.

Secondary Lesions.—Strictures and kinks of the ureter by actually obstructing its lumen cause dilatation of the ureter above and hydronephrosis, infected hydronephrosis, pyonephrosis. Or, conversely, pyelonephritis may cause stricture, or, if the kidney is movable, fixation of a kink and these in turn may dilate the kidney and increase the infection or change it into a pyonephrosis. But the milder types of pyelonephritis tend rather to impair the elasticity of the ureter wall, to interfere with peristalsis and thus to lead to a dilatation of the ureter.

Ureter spasm, on the other hand, usually causes only reflex symptoms.

Symptoms.—The symptoms of these localized ureteral lesions may be classed as reflex, obstructive and inflammatory.

The reflex symptoms are numerous and it is as yet impossible to determine why one patient suffers from one reflex and another some other one. These reflex symptoms are found chiefly in women. The commonest is an irritability of the bladder, characterized by frequent and painful urination. This was present in 75 per cent of Hunner's cases. Pain and tenderness along the course of the upper ureter even amounting to renal colic is also common. Backache, usually in the upper sacral region, pain in the urethra and even generalized abdominal pain also occur, predominantly on the affected side. Digestive symptoms such as indigestion, anorexia, nausea, gas, diarrhea, rectal pain and colitis are enumerated by Hunner. These symptoms are doubtless due to the impairment of renal function and as Hunner makes no distinction between spasm and stricture it seems not improbable that actual stricture, perhaps associated with spasm, is the occasion of most of these. Hunner also mentions dyspareunia as usually due to "stricture," also "ovarian neuralgia" and a sensation of "falling of the womb" in the nullipara.

The obstructive and inflammatory symptoms, due rather to actual stricture or kink than to spasm alone, are those of hydronephrosis, pyelonephritis and pyonephrosis.

Diagnosis.—If the reflex symptoms are as many and as varied as Hunner believes them to be, spasm of the ureter must occasion a great variety of mistaken diagnoses. All urologists see patients whose ureteral pain has been mistaken for appendicitis, whose bladder pain for cystitis, whose renal colic for stone, and can recollect cases in their own practice treated for pyelonephritis and

hydronephrosis without consideration of the ureteral lesion that was their cause.

Ureteral spasm is readily diagnosed by the sensitiveness of the spastic point in the ureter, which is usually within the lower 5 cm., to contact with the ureter catheter and the diagnosis is proven by the relief of symptoms through dilatation. Hunner believes the lesion often associated with submucous cystitis which may have to be cured in order to relieve the bladder symptoms.

Impediment to the withdrawal of the bulbous bougie over the point of stricture is, as we have pointed out, no criterion of the existence of stricture. The bulb is properly employed to measure the progress of dilatation. It should not be necessary to add that the urologist's inability to pass a catheter beyond a certain point in the ureter is generally speaking but an index to his clumsiness. No one should be permitted to explore the ureter who has not learned that much from his practice with urethral instruments.

Ureter stricture and kink are diagnosed by the urogram which shows the obstruction and the dilatation of the ureter and kidney pelvis above. The distinction between true and false kink will be borne in mind.

Treatment.—Prophylactic treatment of possible sources of metastatic infection may not be neglected however little one may believe them the source of infection of the ureter. I am satisfied that a diarrhea or a cold in the head may occasion the recurrence of the symptoms of ureter spasm.

Spasm of the ureter, like its kin submucous cystitis, is usually easy to control, but not always curable. Hunner maintains that many ureters must be dilated to 14 F. or higher in order to prevent relapse of symptoms but most urologists are satisfied to relieve symptoms and clear the urine of pus by dilating to 8, 10 or 12 F. and to relieve relapses as they occur by similar dilatation. But all agree that dilatation is the treatment for spasm.

If dilatation fails to relieve the symptoms the condition is doubtless a true stricture, for though many strictures can be controlled by dilatation some will not admit an instrument, some require divulsion from above downward, through a pyelotomy wound, some are so dense as to require division of the ureter and reimplantation into the bladder. Yet I have a patient with stricture of the ureter near the pelvic brim, which is apparently due to pelvic cellulitis and operation therefor, who came to me three years ago hoping to escape the nephrectomy with which she was threatened because no catheter would pass the obstructed point. I verified the fact, being quite unable to pass the stricture, but my relatively gentle efforts relieved her colics. She returns about once in six months for a single "treatment" as she calls it. I feel baffled, she feels well.

Nephrectomy is the ultimate resort, but it is surprising how this may be avoided when the absence of one kidney makes it impracticable. Kinks, like strictures at the upper end of the ureter, cannot be stretched; they must be operated upon. But the indwelling catheter may tide the case over an acute pyelitis, and if the kink is not absolutely fixed the patient may learn to unkink

it sufficiently by overextending the back, as described under the Treatment of Nephroptosis. My two most interesting cases are worth quoting.

I once relieved an impassible stricture due to impaction of stone near the upper end of the ureter of a solitary kidney by splitting the point of stricture, making a longitudinal incision at a point an inch below this, introducing a 20 F. catheter through this incision through the split strictured area and up into the pelvis of the kidney. This tube was left in for three days, the loin wound slowly healed. Two years later I removed another small phosphatic stone lodged in the upper end of the ureter and at this time satisfied myself that the ureter below the point of impaction was entirely patent. After this operation a single irrigation of the kidney pelvis through a ureter catheter introduced by cystoscope was sufficient to reëstablish ureteral drainage. I last saw the patient entirely well and with clear urine ten years after the first operation. In as much as he had but one kidney, this is satisfactory evidence that intubation of the ureter will sometimes save a seemingly desperate situation.

Stricture at the upper end of the ureter associated with renal mobility and dilatation of the kidney pelvis cannot be stretched. The indwelling ureteral catheter and irrigation of the kidney pelvis may get the patient by periods of acute pyelitis, just as pyelography is almost guaranteed to occasion acute pyelitis in such cases. But the only curative treatment is resection or nephrectomy.

Similarly grave strictures at the lower end of the ureter have usually been dealt with by transplantation of the ureter into another part of the bladder or into skin or by nephrectomy if the opposite kidney is sound.

The cause of such ureteral dilatation and kinking is clear enough in case it is above a definite obstruction. Such dilated ureters are seen quite commonly as the result of urethral stricture, prostatic obstruction, impacted ureteral stone, ureteral stricture, etc. But it is difficult to explain all cases of ureteral dilatation by obstruction alone. Some ureters are both inflamed and dilated and yet no obstruction is found. Braasch is the chief exponent of the theory that in such cases ureteral obstruction does not exist and that the relaxation and elongation of the ureter are atonic effects of chronic inflammation without obstruction. Hunner defends the opposite thesis. The problem seems unsolved at present.

The symptoms are those of infection, perhaps dominated by those of fixed or intermittent hydronephrosis.

In the treatment of such cases, all is confusion. Some authorities depend chiefly upon nephropexy, others depend upon ureter dilatation, others upon positional exercises to encourage the fixation of the kidney high in the loin, others upon lavage of the kidney pelvis.

Whatever treatment is employed should be based upon a diagnosis by repeated ureterograms with the patient in different positions in order to determine exactly what are the kinks and how they are made most manifest.

That postural training should help to unkink the ureter is not surprising

but it is extraordinary that it should have any beneficial effect upon postoperative cases. Yet, sometimes this will happen.

For example, in 1921 I removed a lot of little phosphatic stones and phosphatic grit from the lower pole of the right kidney of a twenty-one-year-old girl and two weeks later removed her left kidney for pyonephrosis. Thereafter she had renal colics on each side, sometimes associated with acute febrile attacks and six months after the operation she passed a last stone from the right side, since which the radiograms have been negative. Thereafter she was found to have a retention of about 20 c.c. on the right side. I kept dilating this ureter every week up to as high as No. 14, but without any permanent relief. She would come to the office in a colic. Emptying her pelvis would relieve the colic and she would go about a week before she would have the next one. Finally I taught her to lie on her back hyperextended with a small hard pillow under her lower ribs the moment she felt an uneasiness in her right loin. From that time on she had no trouble in controlling her colics for six months by this method which she learned to adapt by lying over the arm of a chair. Yet when she returned at the end of this time with a colic, I got an ounce of clear urine from the right kidney pelvis. From then on I never stretched the ureter larger than a No. 10 and a year after this she reported that intervals between her mild right renal colics averaged about thirty days until a year later, in 1925, in order to try my new panendoscope, I passed a No. 14 up the right ureter following which she had eight hours of anuria and nearly died. Since then I catheterize the right ureter about once a year and obtain about 15 c.c. of clear urine negative to culture. She is fat and well, works for her living, and her only complaint is that the vibration of motoring gives her backache.

But in the meanwhile, she had constant pain in the left inguinal region with occasional severe colics there from the time of operation until I had dilated the lower end of the left ureter sufficiently and washed out its lumen often enough to clean up its infection (*B. pyocyaneus*).

A final warning on overtreatment. Overdilatation is bad, witness the case just cited. But persistent dilatation is worse for it keeps the patient a chronic invalid. Patients come to me with a history of dilatation every week for six months, a year, two years! Such patients either have no ureteral lesion beyond that which the treatment inflicts upon them, or they merit operative treatment.

CHAPTER XIX

CYSTITIS

The inflammations of the bladder are reducible to a very small number of clinical types, though each of these types has many variations.

- Non-bacterial cystitis
  - Traumatic
  - Chemical
- Bacterial cystitis: simple
  - Acute
  - Chronic
    - Alkaline
    - Acid
  - Interstitial
  - Pericystitis
- Tuberculous cystitis

The non-bacterial cases will be dismissed briefly. Tuberculous cystitis is considered in a subsequent chapter.

NON-BACTERIAL CYSTITIS

Any strong irritant entering the healthy bladder, whether from above or below, causes cystitis. The intense strangury caused by the administration of cantharides has acquired an undeserved notoriety on account of the alleged sexual excitement accompanying it. The acute prostatic congestion induced by this drug is said to cause priapism, but the sensations of the patient in this condition are anything but pleasant. Rehn first called attention to a similar strangury occurring in coal-tar workers due to inhalation of irritating vapors. Tumor of the bladder ultimately results. The irritation due to hexamethylenamin is well known.

While hyperacid urine is somewhat irritating to the bladder, ammoniacal urine is far more so, and the reason why an ammoniacal cystitis is so much more intense than an acid cystitis is doubtless for this very reason—that the ammonia adds fuel to the fire of bacterial attack.

Cystitis may equally be caused by irritants introduced through the urethra. Nitrate of silver is so often used in concentrated solution that it bears an unenviable notoriety in this regard. Such chemical cystitis may be followed by true infection of the bladder and also the kidney. Mock reported two cases of

gangrene of the bladder following injections made in the hope of producing abortion.

Treatment.—Removal of the cause constitutes the essence of treatment. To allay the irritation the sedative remedies employed in bacterial cystitis may be used.

BACTERIAL CYSTITIS

Cystitis may be acute or chronic, superficial, interstitial, or complicated by pericystitis.

Etiology

Bacteria may reach the bladder (1) from the urethra, (2) from the kidney, and less often (3) by irruption of a neighboring focus of inflammation, or (4) from the blood- or the lymph-vessels.

Bacteria reaching the bladder will not cause any inflammation of that organ unless there is congestion due to (1) retention (mechanical or paralytic), (2) trauma by instruments, stone, or foreign body, (3) disease of the bladder wall, such as neoplasm, tubercle, or simple ulcer, or (4) unless the disease extends directly to the bladder from the neighboring tissues as tuberculosis extends from the ureter, or gonorrhea from the urethra. I have seen cystitis due to direct extension of erysipelas from the vulva.

A cystitis thus begun will disappear spontaneously with the removal of the accessory cause. In short, the surface lesions of cystitis are secondary, not primary. Cystitis should be regarded clinically as a symptom, not as a disease.

Acid cystitis is usually caused by bacilli of the colon type, the tubercle bacillus, the typhoid bacillus, or the gonococcus. Alkaline cystitis is due to staphylococcus, streptococcus or proteus infection. Exceptionally these latter bacteria cause an acid cystitis.

Mixed infection is much more frequent in the bladder than in the kidney. The pyogenic cocci predominate

Pathology

The lesions of cystitis are usually unevenly distributed over the bladder. Indeed, in many acute or mild chronic cases the lesions are entirely confined to the neck of the bladder and the trigone. This so-called inflammation of the neck of the bladder is commonly due in men to some prostatic inflammation, which latter must be attacked in order to cure the "inflammation of the neck." It may be noted here that in every cystitis, whether acute or chronic, the prostatic urethra (and in women practically the whole urethra) as well as the bladder is inflamed, and the vesical inflammation is most intense about the neck and the trigone, unless some special feature of the disease, such as tumor, stone, pouch, produces a distinct focus of more intense inflammation elsewhere in the organ.

Acute Cystitis.—At first there is a sharp congestion most marked about the trigone and the neck, or entirely confined to that region. The mucous membrane is swollen and bright red in color. The capillaries are dilated, the epithelial cells desquamate. The angry crimson of the mucous membrane is blotched by petechiæ, its gloss is lost, and here and there vesicles or superficial abscesses appear. After these break, minute ulcers remain. If these persist, the muscle becomes infiltrated, producing interstitial cystitis.

Exceptionally *membranous or gangrenous cystitis* is seen; *e.g.,* as a result of the combination of trauma and infection from forceps delivery, or as a terminal phase of cystitis in the gravely debilitated subject. I have seen it only postmortem.

Chronic Cystitis.—The *mucous membrane* is irregularly thickened and dense. Its surface is red in color, perhaps mottled by purple or brownish blotches left of submucous hemorrhages. There may be areas of ulceration and granulation. Sometimes the granulations grow to be distinct little villosities several millimeters long. The ulcerations may extend deep into the substance of the organ and communicate (rarely) with abscesses in the muscular tissue. In long-standing cases the epithelium may become cornified in spots, the superficial epithelia being replaced by dense shiny scales resembling the horny layers of the skin (*leukoplakia*). The ulcers may be coated with adherent phosphates. Cystitis cystica and cystitis granulosa are the result of chronic inflammation. Their pathogenesis is not understood.

Gross Changes in the Wall of the Bladder.—In prolonged chronic cystitis the wall of the bladder becomes thickened or thinned, its cavity contracted or dilated, its surface thrown into folds of mucous membrane overlying irregular interlacing bands of muscle-fiber.

These changes are described as hypertrophy (a thickening) or atony (a thinning) of the bladder. Hypertrophy of the bladder may be concentric—when the cavity is contracted—or eccentric—when dilated. The irregularities in the bladder wall are spoken of as trabeculæ, occasioning a trabeculated bladder. or diverticulæ, which extend through the entire thickness of the bladder wall; they are often congenital. Trabeculation occurs in all cases of prolonged chronic cystitis.

Microscopic Changes in the Bladder Wall.—The microscopic changes in the muscle of the bladder afflicted with chronic cystitis have been shown by Ciechanowski to be almost purely sclerotic whether this muscle be thick and apparently hypertrophied or thin and manifestly atrophied. When apparently hypertrophied the increased thickness of the bladder wall is only due in very small degree to actual muscular hypertrophy. It is chiefly due to inflammatory infiltration and sclerosis of the muscle as well as of the interstitial tissue between the bundles of muscle-fiber. The so-called "hypertrophied" bladder may be as feeble as the atonied bladder. The hypertrophy is a false hypertrophy.

The various degrees of hypertrophy and atony are due to the interplay of inflammation and retention. If the retention is slight or absent and the

inflammation severe, the bladder undergoes concentric hypertrophy. If retention is marked and inflammation mild, dilatation and atony result.

Submucous cystitis consists in an extensive mild chronic infiltration of submucosa and muscle in the mobile portions of the bladder. The bladder cavity is contracted, the mucosa inelastic. It cracks on distention and the healing of such cracks leaves bands of narrow scar enveloped in patches of mild chronic cystitis with here and there ulcers of a small "aphthous" type, or wide and granulating. The derivative character of the secondary ulcers is disclosed by repeated cystoscopies. Each time a different picture is seen, all but the oldest ulcers and the bands of mucosal scar shifting from place to place. Searching bacteriological examination reveals *Streptococcus viridans* in a surprising number of these cases.

Abscess.—Abscess of the bladder is rare. Small abscesses of the mucous membrane may run their course unnoticed. Abscesses within the wall of the bladder may begin in a diverticulum. They burst into the bladder, leaving deep necrotic pockets, which may continue to suppurate indefinitely, or lead to perforation. Purulent venous thrombosis may result.

Pericystitis.—The changes that occur in the connective tissue surrounding the bladder are usually of a protective character. An intense chronic cystitis provokes a thickening of the perivesical tissue and of the peritoneum. Less frequently a diffuse fibrolipoma occurs, comparable to the perirenal fibrolipoma, and, like it, protective in character. In such cases the fibrous masses may often be felt through the rectum, and I have known them to be mistaken for cancer of the prostate until cystotomy showed the prostate to be normal. When there is much pericystitis the bladder is usually found in a state of concentric hypertrophy with fibrous, undistensible walls.

Suppurative pericystitis is usually due to trauma or to prostatic abscess.

Symptoms

The three accepted symptoms of cystitis are:

1. Pus in the urine (pyuria)
2. Frequency of urination
3. Pain; notably pain with urination

But of these only one—viz., pyuria—is constant. There is but one exception: submucous cystitis from time to time, when the ulcers are all but healed, shows no pus in the urine. Pus, frequency, and pain may be due to chronic posterior urethritis without cystitis or to pyelonephritis without cystitis. If the condition is acute, this triad does indeed suggest cystitis; but chronic pyuria, frequency, and pain, in the absence of retention, suggest prostatitis or pyelonephritis rather than cystitis.

Hematuria if solely due to cystitis is slight, even microscopic, and tends to appear at the end of urination, as terminal hematuria.

Though patients suffering from cystitis often exhibit such symptoms as chills, fever, sleeplessness, anorexia, and loss of flesh and strength, these symptoms are not directly referable to the inflammation of the bladder. The febrile symptoms are due either to inflammation of the prostate or to implication of the kidneys, and the loss of appetite, sleep, and strength is due to the distressing symptoms of pain, dysuria, and tenesmus.

TYPES OF THE DISEASE

Cystitis is not a disease. The normal bladder is singularly resistant to infection. The trigone readily becomes inflamed by extension of inflammation from the urethra or the ureters. Thus the cystoscope not infrequently reveals a trigonitis of urethral origin in the female, and would reveal it far more often in the male did we not fear to cystoscope patients during gonorrhea. Also the inflamed ureter mouth with adjacent trigonitis is a familiar cystoscopic picture. But such inflammations commonly remain localized and do not properly constitute a cystitis unless retention, trauma, stone, or tumor make the bladder vulnerable.

Cystitis, whether acute or chronic, is always a secondary infection, dependent upon something else; we should never think of it as primary. When we do we are often using the word "cystitis" to cover some important pathological fact such as infection of the kidney. For instance, acute gonorrheal cystitis is a matter of no importance; the important lesion is the acute gonorrheal prostatitis. Acute postoperative cystitis is a matter of no importance; the important thing is the retention, the important inflammation, the acute renal infection. The same is true of the colon cystides. The cystitis of childhood, the cystitis of pregnancy, etc., are usually nothing more than names to hide a renal infection.

Therefore, let it be understood that in speaking of cystitis we use the term with the greatest reserve and, though recognizing that cystitis may, under unusual conditions (e.g. submucous cystitis), exist as a separate entity, we prefer to think of it rather as a lesion accessory to a urethritis, a prostatitis or an infected kidney.

Acute Cystitis.—Acute cystitis is characterized by very frequent and very painful urination both by day and by night; the act of micturition terminates in a series of exquisitely painful spasms, efforts of the inflamed bladder to squeeze out a few drops of urine more after it is actually empty. The urine contains pus and bacteria, usually blood. The blood may be terminal, a few drops of almost pure blood coming at the end of the urinary stream.

Acute cystitis is not characterized by the brevity common to most acute inflammations. If due to gonorrhea or to instrumentation it is self-limited, unless there be retention, but if due to chronic causes such as retention, stone, tuberculosis, ulcer, submucous cystitis or tumor, the acute symptoms continue in dreadful intensity for an indefinite time. The intense, protracted, repetitious

bladder spasm of urination results in a state of tonic spasm, a constant, excruciating ache to which the name strangury has been given. Strangury lasting day after day, permitting not one moment of peaceful sleep, utterly exhausts the patient and drives him to morphin. If the inflammation causing the strangury is curable (and incurable carcinoma of the bladder is the only cause of acute cystitis that is not) the strangury must be promptly relieved by decompression, lest the patient be left a morphin addict.

Chronic Cystitis.—Chronic cystitis is, as stated above, essentially secondary to some other lesion.

It may produce no symptoms; thus the patient with a paralyzed bladder, whose symptoms are under control by catheterization, may show quite an intense cystitis to the cystoscope, but have no subjective symptoms whatever. The urine merely contains pus; there is no frequent or painful urination.

It is characteristic, however, that the inflamed mucosa does not stretch as kindly as the uninflamed bladder, consequently the intervals between urinations are usually short, and each urination not free from discomfort. There is frequent and painful urination and pus in the urine. The intensity of these symptoms usually depends upon the retention, stone, etc., causing the cystitis.

Ulcerative Cystitis.—Ulcers, small or large, deep or superficial, occur from time to time in any type of cystitis, acute or chronic. These are noted by cystoscope, but assume no clinical significance. But tuberculosis, carcinoma and syphilis apart, the cystoscope has disclosed three types of ulcerative cystitis, as follows:

The elusive ulcer, due to submucous cystitis, depicted in several of the older atlases of cystoscopy, but first described and studied by Hunner, consists of a lesion which well deserves its title. As we now recognize it the clinical picture of elusive ulcer represents what must be an extreme example of a much more frequent and much milder condition. But the striking clinical feature of the disease is *a violent chronic irritation of the bladder without any gross evidence of cystitis.*

The elusive ulcer appears to the cystoscope as one or more inconspicuous ulcerations, situated upon the mobile portion of the bladder, usually in the mesial portions of vault or fundus. The striking characteristics of the ulceration as seen by cystoscope are the following:

1. It is extremely sensitive to distention, thus greatly reducing the bladder capacity, and to touch, so that if the patient can be cystoscoped without general anesthesia a sharp pain may be evoked by touching the ulcer with a ureter catheter.

2. It bleeds readily when touched or even as the result of bladder distention.

3. Though the ulcer is often surrounded by only a narrow band of infiltrated mucosa, from which scarred folds of mucosa may radiate, yet if examined repeatedly it never looks twice the same. Ulcers disappear from one spot to appear in another; indeed, during the course of an examination under anesthesia —and the patient often will not permit examination without anesthesia—the

bladder mucosa may be seen to crack and bleed at points that appeared quite normal but a moment before.

4. The bladder capacity is markedly reduced. The limit of distention is usually below 100 c.c.

These cystoscopic characteristics depend upon the fact that the elusive ulcers are but superficial manifestations of the extensive underlying submucous cystitis. The elasticity of the bladder wall is impaired by this interstitial lesion; it cracks like a chapped lip. The etiology and early history of the interstitial cystitis are not well understood. Hunner insists upon focal infections about the upper air passages as the frequent cause of the lesion and of its continuance.

The patient complains of most intense cystitis. Not only is urination frequent and painful, it may be almost a constant dribbling, with hours together when the bladder is in exquisitely torturing strangury. There is, indeed, so little superficial cystitis that for long periods of time during which the patient suffers untold agony there may be *little or no pus in the urine,* while the few bacteria discernible by culture may be attributed to contamination. Under such circumstances the patient, usually a woman, is accused of pyschasthenia or hysteria, for cystoscopy reveals no gross lesion of bladder or kidney and the wee elusive ulcer of vault or fundus readily escapes detection. It is only by deliberately looking for these ulcers that we find them.

The course of the malady is utterly chronic, the symptoms getting better and worse, fluctuating with the patient's condition, debility and intercurrent infections. For the history to go back fifteen or twenty years to the patient's youth is not uncommon. Spontaneous alleviation of the symptoms occurs if the patient can get physical rest. Hence the condition is merely the occasion of a quasi-invalidism to the rich woman, but is a torture to the poor.

The solitary ulcer, as described by Fenwick,[1] is doubtless but a large chronic elusive ulcer. The ulcer affects the same regions of the bladder and overlies an interstitial cystitis of far greater extent than the ulcer itself. But the cystoscopic picture is quite different. The ulcer is large, in fact, I have excised one that was 5 cm. in diameter, fixed, obvious. It is a red velvety granulating surface, surrounded by an indurated border, and set in a chronically inflamed bladder. The urine is constantly purulent and contains staphylococci. There is often an associated pyelonephritis, though this is rare with the elusive ulcer. Yet the symptoms of the solitary ulcer are not, could not be, more severe than those of the elusive ulcer.

Incrusted ulceration of the bladder is quite another matter. It is due to infection by a specific bacterium (see Chap. XXVI) and excites intense cystitis. The phosphatic incrustations may be disseminated throughout the bladder on small areas of ulceration but, while usually multiple, tend often to group about the bladder neck and on the trigone. To the symptoms and cystoscopic picture of a most intense cystitis, amid which the incrustations are seen with

[1] *Brit. M. J. Lond.,* 1896, i, 1133; *Ulceration of Bladder,* London, 1900.

difficulty because of the free bleeding, this type of ulcer adds free spontaneous hematuria. It is very commonly mistaken for incrusted carcinoma because of the symptom-complex, spontaneous hematuria and intractable cystitis, fortified by a cystoscopic picture readily mistaken for incrusted tumor.

Cystitis Cystica and Granulosa.—These lesions, like the similar ones in the kidney pelvis and ureter, are apparently due to chronic inflammation. They

FIG. 52.—CYSTITIS CYSTICA ADJACENT TO A CARCINOMA OF THE BLADDER.

cause a slight pyuria and usually as slight frequency of urination. They appear to the cystoscope as little miliary, pinkish, discrete or agglomerated bodies in the mucosa, chiefly about the trigone. The cysts are quite translucent (Fig. 52).

Leukoplakia.—This, like the two conditions just mentioned, may occur in the kidney pelvis or in the vault of the bladder; it is quite obviously due to chronic inflammation in the urinary organs; it does not seem to give rise to carcinoma as it does upon the tongue. It causes chronic pyuria with frequent and painful irritation, and perhaps hematuria.

Pericystitis.—Adhesive and fibrolipomatous pericystitis gives no symptoms.

Suppurative or phlegmonous pericystitis may result from infection within the bladder, as stone, diverticulum, retention, or may arise from the adjacent organs, as the appendix, fallopian tube, vas deferens, or from trauma, due to operation, fracture of the pelvis, rupture of the bladder, or from the prostate or seminal vesicles. The infection may be localized in the space of Retzius or in the region above the prostate. General symptoms of septicemia may predominate in the clinical picture; a mass may be felt above the pubes or above the prostate, suggesting carcinoma. There is likely to be cystitis as well.[2]

DIAGNOSIS

The diagnosis of cystitis is of no particular importance. The diagnosis of its character and cause may be most important. This is achieved chiefly by cystoscopy.

The mildly inflamed mucosa of the vault may look quite normal to casual inspection; but the *blood-vessels cannot be seen on the inflamed regions.* This is the distinguishing cystoscopic characteristic of the inflamed bladder. When intensely inflamed it is scarlet, swollen, eroded or ulcerated.

The inflamed trigone can be better observed through a straight tube, which shows the irregularities, inflammatory, edematous, cystic of that region in profile.

The elusive ulcer will be seen if looked for in the subperitoneal region. Here again the straight tube may find lesions that the prismatic cystoscope overlooks. The bladder is always contracted.

The incrusted ulcer may be multiple and superficial, but is usually single and deep. But in the best of clinics the large, single, infiltrated, incrusted ulcer is often mistaken for carcinoma. Both biopsy and cystogram may only confuse the diagnosis. When in doubt, a few doses of ammonium chlorid and hexylresorcinol, with a daily injection of 5 c.c. of 10 per cent argyrol, gomenol or 1:300 mercurochrome, serve for diagnosis and the beginning of treatment.

But the most important part of the diagnosis is the discovery of the cause of the cystitis. This implies a thorough understanding of the phenomena of infection and retention as detailed in Chapters XI and XIII.

Differential Diagnosis.—When there is a considerable amount of pus in the urine the differential diagnosis centers about the renal or prostatic inflammation or retention or the bladder stone, tuberculosis, ulcer or tumor which may be the cause of cystitis.

But when the pus is slight in amount or for the moment lacking, the following conditions are to be considered:

Anal fissure exceptionally causes great frequency of urination and little or no rectal disturbance.

Diabetes insipidus and *diabetes mellitus* must be ruled out.

Prostatic sclerosis and *tabes* must be suspected and ruled out, the one by

[2] *Cf.* Chute, *Boston M. & S. J.*, 1909, clxi, 438.

urethroscopy, the other by spinal tap, for each may occasion considerable bladder irritation with or without actual cystitis, and with little or no retention of urine.

Renal tuberculosis, and more rarely *prostatic tuberculosis,* should always be gravely considered.

In the absence of these an elusive ulcer may be confidently sought.

TREATMENT

The treatment of cystitis is primarily the treatment of its cause, be this gonorrhea, retention, stone, tumor or what not. This done the cystitis usually cures itself.

The irritation of the bladder may often be alleviated by the administration of sandalwood oil, or by the hyoscyamus and alkali mixture. Instillations of 5 or 10 c.c. of 10 per cent argyrol may prove wonderfully soothing or daily irrigations with 1 : 6,000 solution of potassium permanganate or silver nitrate should be given until the symptoms are alleviated. If there is tabetic retention, hexamethylenamin alone often controls the infection. Diuresis may relieve symptoms; it does not cure the inflammation.

Elusive ulcers should be attacked as follows:

1. Rest in bed. Eliminate teeth and tonsils as sources of infection.

2. Regulation of diuresis. The patient knows that his comfort depends upon drinking a good deal of water. He forms the panicky habit of drinking far too much of it. The desirable mean must be found.

3. The diet should be light and exclude alcohol and spices.

4. Narcotics are a plague. These patients very readily become addicts.

5. Sandalwood oil or alkalies may help. Hexamethylenamin and hexylresorcinol can only irritate.

6. The decompression apparatus in the hands of an expert nurse may give the bladder that rest it needs at the onset.

7. The curative treatment consists in antisepsis or cauterization. Argyrol or gomenol may help at first; 5 c.c. of 1 : 200 mercurochrome twice daily, if it can be borne, may cure.

As a rule, however, it is necessary to give a caudal anesthetic and attack the ulcer directly, after exploration with the cystoscope, by sparking or strong chemical cauterization, as for posterior urethral granulations, through a urethroscope. Each such treatment should, after a few days of reaction, leave the patient so much improved that he is willing, if necessary, to submit in a month to another cauterization.

8. Large resection of the ulcers and the surrounding infiltrated area was practiced by every one ten years ago. The immediate results are so satisfactory, in about 60 per cent of cases, that reports of that time are pæans of surgical enthusiasm. But the sober lapse of time has seen most of these patients relapse.

If resection is to be employed it must be as a last resort and merely as an incident.

9. Hunner believes that ureteral dilatation is an essential part of the treatment of submucous cystitis.

Incrusted ulcerations can usually be cured by instillation of argyrol, etc., as used for diagnosis. Litholapaxy may be required to remove large masses of phosphates. Operative removal of the incrustations is most unsatisfactory, as the infection is rather encouraged thereby and grave infection of the wound ensues.

Dilatation of the contracted bladder is useless. As Guyon long ago observed, the capacity of the bladder is physiological and not anatomical. If the lesion causing the contraction cannot be cured, stretching the bladder will do no good.

Suppurative pericystitis requires surgical drainage.

CHAPTER XX

PROSTATITIS; VESICULITIS; POSTERIOR URETHRITIS

Inflammations of the prostate have in the past been considered of interest chiefly in connection with gonorrhea. Indeed to many clinicians prostatitis still is almost synonymous with gonorrhea. No notion could be more erroneous. The prostate may be infected in a variety of ways:

By extension of gonorrhea from the anterior urethra.

By the bacteria normally found in the anterior urethra. These bacteria cause prostatitis in many ways: By the passage of urethral instruments which carry the bacteria to the prostate and at the same time traumatize it, by sexual strain which so congests the organ as to render it unduly infectible, and by the presence of prostatic calculi which have the same effect.

By the lodgment of foreign bodies introduced from without or of urinary calculi lodging in the prostatic urethra.

By urethral retention of urine, whether due to stricture or to prostatism.

By inoculation with bacteria descending from the kidney or the bladder. Hence almost every pyelonephritis in the male is accompanied by prostatitis.

By metastasis, notably from acute infections of the upper air passages. Thus every winter one sees acute prostatitis, often accompanied by pyelonephritis, as a complication of so-called "influenza."

In analyzing the cause of an acute prostatitis it must be remembered that chronic prostatitis is very common, usually symptomless. Hence any acute inflammation of the gland may be, like an acute nephrosis, only an outbreak of acute inflammation in a gland already the seat of chronic infection. Indeed, it is not improbable that few prostates, once infected, ever entirely rid themselves of bacteria. Given the frequency of gonorrhea and of "influenza" in youth, the adult prostate can no more be guaranteed free from silent chronic infection than can the adult tonsil.

In youth gonorrhea and sexual strain are the usual causes of acute prostatitis; in middle life, influenza, pyelonephritis, urethral stricture; in old age pyelonephritis, prostatism, influenza.

Seminal vesiculitis is a common accompaniment of prostatitis. So is posterior urethritis.

ACUTE PROSTATITIS AND PROSTATIC ABSCESS

Acute prostatitis begins as an acute inflammation of the prostatic ducts and acini and of the overlying posterior urethral mucosa. It is usually accompanied

by seminal vesiculitis. The pathologist recognizes a catarrhal prostatitis in which the inflammation extends only to the ducts but does not reach the acini, a follicular prostatitis in which the infection reaches the acini but does not invade the stroma, and a parenchymatous prostatitis in which actual suppuration occurs in small multiple foci throughout the gland, which foci may resolve or may coalesce to form a prostatic abscess. But doubtless every acute prostatitis recognized by the clinician is in some degree parenchymatous.

The acutely inflamed prostate occurring in the course of a gonorrhea is not diagnosed, if mild, until the acute urethritis has subsided and left behind a chronic prostatitis. If mild and due to pyelonephritis it is usually overlooked. But if due to metastasis it is recognized by the discharge of pus, or pus and blood, in the first flow of urine and by the pus that may be expressed from the gland by rectal palpation.

Acute parenchymatous prostatitis causes gross changes in the contour of the gland that may be recognized by rectal touch. The prostate is swollen, tense, tender, and if the suppuration is so intense as to extend to the periprostatic tissue, edematous and perhaps immersed in a mass of periprostatic phlegmon so dense that the outline of the gland is completely lost and the finger in contact with the anterior wall of the rectum can differentiate no anatomical landmarks amid the swollen, tender, lumpy exudate.

Prostatic abscess cannot be distinguished clinically from acute parenchymatous prostatitis. Indeed the prostate undergoes no gross change as the miliary abscesses coalesce to form one large abscess in each of the lateral lobes. I have never recognized an abscess of the posterior lobe. After the lobe is fully broken down, rectal touch recognizes an elasticity in the swollen lobe like that of a soft-walled abscess.

The prostatic abscess terminates by rupture into the urethra or into the periprostatic tissue. From the periprostatic space it may rupture into the rectum, and very rarely into the peritoneum, but is much more likely to burrow downward along the membranous urethra in front of Denonvillier's fascia, into the perineum where Buck's fascia (Fig. 60) guides the pus forward into the scrotum where it will be operated upon as a periurethral abscess, or whence it may burrow to the groin and belly.

Symptoms.—It is as impractical to attempt to distinguish acute posterior urethritis from acute prostatitis as it is to distinguish acute pyelitis and acute pyelonephritis.

Unless there is prostatic abscess the symptoms are those of acute inflammation of the bladder. Urination is frequent and painful and not to be denied. The frequency of this urgent call may be so great that the patient dribbles a few drops of urine every few minutes night and day. A frequency of less than once an hour may be accounted mild.

If the inflammation is not overacute the pain is referred to the end of the penis, usually to a point on the under surface of the urethra just behind the glans penis. If more severe the pain may also be felt above the pubes, in the

perineum, down the thighs, up the rectum, over the sacrum. Perineal pain is attributed to the prostate, suprapubic pain to the trigonitis, sacral pain and pain in the loin to seminal vesiculitis. But this attribution is far from accurate. Any one who has performed suprapubic cystotomy under local anesthesia knows that irritation to the vault of the bladder causes pain in the end of the penis. Uninflamed bladder tumors often excite pain in the back.

The tension upon the capsule of the acutely inflamed prostate causes a sensation as of a hot potato up the rectum.

When the acutely inflamed prostate is sufficiently swollen to impede the outflow of urine the resulting dysuria is similar to that suffered by the prostatic. There is retention of urine though no account is taken of this until it becomes complete and the patient is wholly unable to urinate.

When the urine is passed in two glasses both are purulent. If the symptoms are intense, the terminal spasm is such as to squeeze out a few drops of blood from the surface of the posterior urethra. A "terminal" increase in the pain of urination and "terminal" hematuria are characteristic of posterior urethritis.

When abscess is developing in the prostate the symptoms are those of an acute posterior urethritis, urination extremely frequent and intensely painful, often with terminal hematuria; or there is acute complete retention of urine. Often the two types combine and the patient suffers pain, frequency and retention all at once.

The temperature curve of prostatic abscess is unusual but typical. For a day or two at first it rises to 103° or more. From this point it rapidly falls to below 100° and there remains, hanging around normal in a most misleading manner until the abscess bursts or is operated upon. With this the temperature rises perhaps higher than at first and again rapidly falls to normal. This afebrile condition should not mislead one as to the presence of pus in the prostate.

Periprostatic perineal abscess is recognized as such by rectal touch which detects the swelling along the membranous urethra and about the prostate.

Complications.—Posterior urethritis and vesiculitis always accompany acute prostatitis. There may be an accompanying or preëxisting pyelonephritis. The inflammation in the vesicle often extends to one or both epididymes.

Periprostatic abscess is an extension of the infection. General sepsis and metastatic infections or arthritis are equally rare. I have seen one patient die of incrusted bladder ulcer complicating operation for the relief of prostatic abscess.

Diagnosis.—As stated above, mild acute posterior urethritis and prostatitis escape observation during the course of an acute gonorrhea. But if acute enough to give symptoms the onset of frequent and painful urination and the appearance of pus in the second flow of urine establishes the diagnosis.

Prostatic abscess may be suspected when retention of urine occurs or the prostate is felt by rectum to be swollen, edematous, etc.

Acute prostatitis occurring during the course of a pyelonephritis doubtless

escapes notice. Occurring as a complication of influenza it is usually mistaken for pyelonephritis, now that the general practitioner is accustomed to the idea that renal infection gives bladder symptoms. But the prostatitis is readily diagnosed by expressing pus from the prostate. The pressure should be very gentle for fear of exciting prostatic abscess. Indeed, the gland is often so swollen that no further proof is needed.

Treatment.—The most important part of treatment is to avoid trauma to the gland. The patient must be still in bed or at least avoiding all physical strain, such as lifting or rapid walking, jolting, as in motor or train riding, and sexual exercise. The forcing of fluids is limited by the retention of urine.

The physician should examine the prostate as rarely and as gently as may be, and massage it not at all. A suspensory should be worn.

Codein and the bromids in large doses will slightly diminish the pain. Balsamics and alkalies may soothe urination. I hate to use morphin. Hot

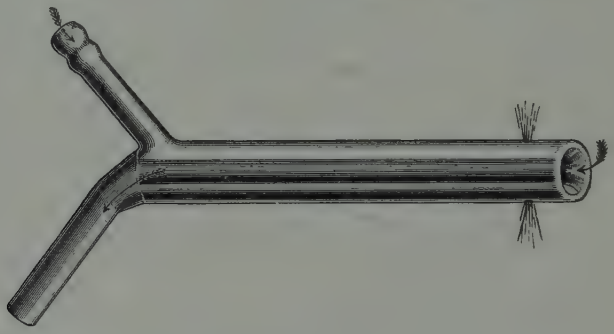

FIG. 53.—CHETWOOD'S DOUBLE-CURRENT TUBE FOR RECTAL IRRIGATION.

sitz-baths several times a day relax spasm. The hot rectal douche once or twice a day is even more efficacious.

The douche is given through a double-current tube, or through two large urethral catheters tied together, as follows: A fountain syringe is filled with water as hot as the finger can bear, about 125°, and hung at the height of the patient's head as he sits on the toilet seat. The tube is attached, filled, greased with vaseline and inserted as the patient sits on the seat; if he lies down the water will run up the colon and not heat the prostate. When both inflow and outflow work, this is witnessed by the trickle of water into the bowl. The ideal irrigation uses the two quarts but it takes the patient several days to learn the trick. At first he simply fills his rectum with water and blows this out alongside the tube. Yet I prefer the tube to the psychrophore which runs the water in and out through a closed metal tube without permitting it to come in contact with the rectum.

As the acute symptoms subside prostatic massage of the prostate is begun in the gentlest possible manner and continued as for chronic prostatitis. No urethral treatment should be given during an acute posterior urethritis except the

necessary catheterizations to relieve retention. A single catheterism often gives relief. Silver nitrate instillations used to be employed to relieve pain in a more barbarous age.

The Stevens operation for prostatic abscess is indicated when the symptoms of posterior urethritis become unbearable, though the operation does not immediately relieve these; or when retention of urine lasts more than twenty-four hours, or when an abscess can be palpated by the rectum and one feels sure it is not periprostatic. For periprostatic abscess, whether above or below the levator ani, the operation should be through the perineum.

The Stevens operation immediately relieves retention. Only one of our many cases at Bellevue had to be catheterized once after the operation. It never fails if there is an abscess and this is not periprostatic. It does not delay healing or prolong posterior urethritis, as my experience in private practice attests. It keeps the patient in bed only forty-eight hours.

CHRONIC PROSTATITIS

To the examining finger the chronically inflamed prostate may show no change. More commonly it is enlarged. This enlargement consists of a general bulging of one or both lateral lobes or the presence of masses of induration in or about the gland.

The general enlargement of a lobe may be tense and irreducible by pressure, or it may soon yield to massage, leaving in its place a sunken pit surrounded by a more or less clearly marked rim of induration. With this subsidence of a swollen lobe under massage there is an outpouring of purulent prostatic secretion from the meatus. Such a lobe we call boggy.

The indurations may be prostatic or periprostatic. They are irreducible by a single massage, but usually diminish in size or disappear after repeated massaging or even, in time, without massaging.

"Periacinous infiltration is so invariably present that we may speak of it as the essential lesion of chronic prostatitis. Sometimes it is combined with more extensive interstitial and endoglandular processes, but not infrequently in extensive areas the periacinous lesions may be present alone.

"The changes in the acini are manifold. In some instances the culdesacs are dilated; this dilatation . . . may be due to stricture or obstruction in the excretory ducts, but is probably more often the result of an accumulation of inflammatory products in the glandular sacs, the muscular tone of whose walls has been injured by the inflammatory process. Acini, however, the caliber of whose lumina is diminished, are almost as frequently seen as are dilated ones, and this is especially true where the prostatitis is of long standing and an extensive periacinous sclerosis has formed. At times the acini are mere vestiges or may even be entirely replaced by fibrous tissue in areas of considerable extent. The acini are often partially or entirely filled with proliferating and desquamated epithelium" (Young, Geraghty, and Stevens).

The lesions are unevenly distributed about the gland. Areas, large or small, of normal gland are usually present, and in some instances the diseased area is confined to that part of the gland adjacent to the urethra.

The dilatation of the acini may be very considerable. This dilatation is the foundation for Ciechanowski's theory of the inflammatory origin of prostatism.

Changes in the Secretion.—The normal prostatic fluid is an opalescent fluid, alkaline to litmus, and acid to phenolphthalein, whence the arguments as to its reaction. As obtained by massage, it usually contains gelatinous, transparent masses of vesicular secretion. The pure normal prostatic secretion is filled with minute translucent, lecithin bodies. It contains a moderate number of columnar and round epithelia, the nuclei of the latter almost filling the cell body, a very few leukocytes, less than five to the field, a few corpora amylacea, and some red blood-cells from the trauma of massage.

The abnormal prostatic secretion is purulent. It is not so opalescent as the normal secretion. When mingled with urine, which is passed after massage, it often looks granular and flaky to the experienced eye. There often settles at the bottom of the glass a deposit of crumblike purulent masses in shreds. The normal elements are in inverse proportion to the amount of pus. The reaction, like that of the normal secretion, is acid or alkaline according to the reagent employed. Bacteria are sometimes present in great numbers. In rare instances pus is only obtained after the second or third massage, the secretion expressed after the first massage being exclusively from the normal portions of the gland.

The diagnosis of pus in the prostatic secretion can be made only with the aid of the microscope. The normal prostatic secretion cannot be distinguished as such by the naked eye.

The bacteria found in the secretion from the chronically inflamed prostate are usually staphylococci, rarely bacilli of the colon group, gonococci, streptococci, proteus, etc. Bacteria are more readily identified on smear than in culture. About half the more chronic cases fail to show bacteria either on smear or in culture.

Prostatic sclerosis is the outcome of prostatitis long drawn out. Scar replaces the parenchymatous exudate, while mild suppuration continues in the acini. The scar renders the prostate rigid and the effect of this is to interfere with the normal elasticity of the bladder neck. It remains contracted, and in as much as the bladder neck is attached to the pubes the contraction occurs at the expense of the floor; *i.e.*, the floor of the bladder neck is drawn upward and inward, away from the veru, and fixed there.

In the course of a chronic prostatitis certain changes take place on the surface of the urethra as the result of chronic inflammation there, which are described at the end of this chapter.

Clinical Picture.—Chronic prostatitis is usually, but not always, associated with chronic posterior urethritis and chronic vesiculitis. But since it is possible to distinguish the three lesions quite clearly from one another and since the in-

flammation is likely to be more marked in one, their symptoms may be described separately.

The milder forms of chronic prostatitis occasion no symptoms whatever. If there is no posterior urethritis the urine is perfectly normal, there are no sexual derangements, no pains, no frequency of urination. Examination of the prostate by rectal touch may disclose no abnormalities about the gland. But massage of the prostate squeezes out a purulent secretion.

But as a rule a mild posterior urethritis accompanies the prostatitis; there is pus in the urine. But it is equally the rule that this pus is so small in amount that if the urine is passed into two glasses the pus is all ejected into the first glass. There is not enough of it to flow back into the bladder between the acts of urination. The second flow of urine is clear.

If the prostate is unusually distended with pus the expulsion of the last few drops of urine may so squeeze the gland as to empty it of some of its secretion which appears in the second urine passed. Indeed, if the prostatic pus is considerable in amount and readily expressed the second urine passed may be more purulent than the first. Under these conditions, if the urine is passed into three glasses without interruption of the act of micturition, the first glass is clouded with pus, the second relatively clear, the third more cloudy than the first. With this there may or may not be terminal pain.

The sclerotic prostate is always the seat of chronic prostatitis. But its symptoms are those of prostatic obstruction to urination. If the sclerosis is slight, sexual symptoms or pain symptoms such as are associated with non-sclerotic prostatitis may predominate; but if the sclerosis is rigid enough to obstruct urination, these discomforts are not complained of.

Prostatic sclerosis, like the chronic prostatitis from which it springs, is for a long time a silent malady. In this symptomless state it is often discovered by the posterior urethroscope. The tube meets an obstacle at the bladder neck over which it must be lifted by deep depression of its ocular end. Once in the bladder it lies with its bladder end still elevated by the bar at the neck of the bladder over which it has ridden, just as though there were prostatic enlargement. As the tube is withdrawn into the urethra the depth and distance it sinks before reaching the veru are noted, and the difficulty in getting the instrument realigned with the orifice of the bladder neck. There is a tight bladder neck due to prostatic sclerosis and yet there may be no symptoms referable to this for years.

When symptoms do supervene, they are, as has been stated, those of prostatism. But the sclerotic prostate has other peculiarities besides evoking no symptoms when the obstruction seems well developed. As a malady it is prone to progress in one or two opposite clinical types. Either the retention develops silently until the bladder is full to the umbilicus with only the digestive symptoms of renal insufficiency to show for it and scarcely any disturbance of the frequency or ease of urination; or else it takes the opposite course and occasions great bladder irritability at a period when the residual urine varying from 20 to

50 c.c. seems scarcely adequate to account for the symptoms and the urethroscopic picture is the only proof that the patient is not neurotic.

It is in the symptomless stage that the sclerotic bladder neck obstructs sufficiently to occasion the cystitis which is the first clinical evidence of bladder diverticulum.

Symptoms.—The symptoms of chronic prostatitis are:

Pus in the prostatic secretion and, if there is posterior urethritis, in the urine and even as a discharge from the meatus.

Pain under the glans penis, in the perineum, over the pubes, in the region of the sacro-iliac joint, down the thighs, in short anywhere in the pelvis or the adjacent regions. Or the disturbance to sensation may not amount to pain. The patient may prefer to describe it as a discomfort, an itch along the urethra, a burning, a desire to urinate.

These discomforts and pains are sometimes closely associated with the act of urination, sometimes not.

Frequent and difficult urination is due not so much to the chronic prostatitis as to the posterior urethritis or to prostatic sclerosis.

Prostatorrhea is a condition in which the muscles of the prostate are so relaxed that the gland is always full of secretion and every constipated movement of the bowels squeezes one or several drops of this opalescent sticky fluid out of the meatus, to the horror of the patient. Indeed, in some cases the prostate is thus milked by every bowel movement and even by the act of urination. This is harmless and wholly incurable. It does not in any way impair the sexual function or shorten the sexual life. I have lived long enough to know that. It is due to prostatitis, but it does not imply the existence of prostatitis, for the extruded fluid is often quite free from pus. Many men have prostatorrhea for years and never know it. But if they notice it and become aware that the drop contains spermatozoa, instead of being cheered by that news, they may contemplate the theory of "errors of youth and loss of manhood" until they think themselves impotent. Doubtless prostatorrhea is in part due to sexual strains such as masturbation overfrequently or "necking parties" or withdrawal during coition.

Disturbance of the sexual function is an alleged sequence of chronic prostatitis, but is allied rather to disease of the veru.

Arthritis and other metastatic infections may result from inflammation of the prostate. The gross anatomy of the prostate and of the tonsil are so much alike that absorption and metastatic infection should be as common from the one as from the other. Indeed, this is doubtless the case. But in tonsillectomy we have a relatively minor operation by which we can check up our opinion as to the tonsillar source of such infections. The glandular portion of the normal prostate cannot be enucleated. Hence, given the infection of the prostate and a metastatic inflammation, we have no certain means of arriving at a decision as to the connection between the two. The identification of a streptococcus in the prostatic secretion to which a positive blood fixation can be obtained is

suggestive evidence, though the same streptococcus may be hidden in the root of a tooth or in the tonsils. Streptococcus autogenous vaccines are believed to have helped some such cases. Massage of the prostate manifestly benefits a few; but the claims of vesiculectomy sound more striking.

I have had little luck in relieving arthritis or sciatica by prostatic massage, apart from a few striking cures. But the enthusiasm of von Lackum [1] should be recorded. Among his cases "approximately 40 per cent of prostatitis is hematogenous and dental and tonsillar infection is responsible for many of these cases. . . . Latent prostatitis is a definite clinical entity and without provocative treatments many cases are undiagnosed and in others maximal relief is not attained. . . . Pyuria is relatively uncommon in focal prostatitis. . . . Animal experiments show localization which provides additional support for the theory that the prostate acts as a focus for systemic infections. . . . Prostatic focal lesions are comparatively common and no investigation of foci in the male is complete without a thorough examination of the prostate gland."

Von Lackum noted, as every one else has done, the marked discrepancy between the gross changes palpable in the prostate and the degree of infection. But he has gone further than others in recommending that when pus is absent from the prostatic secretion latent infection should be stirred up by "vigorous provocative measures, preferably with the Kollmann dilator," or with instillation of 0.25 to 1 per cent silver nitrate. Most prostates can certainly be made to show pus by such irritation.

He gives the following results of treatment: For chronic infectious arthritis, fourteen relieved, sixty-four improved, six unimproved; for sciatica "attributed to true ganglionitis and ranging from one month to ten years' duration, relief varied from 50 to 100 per cent after an average of nineteen vigorous treatments of the prostate." Sixty cases were treated. "As in the arthritis series, some of these patients were under medical care at the same time."

Diagnosis.—The diagnosis of prostatitis is made by the discovery of pus in the prostatic secretion. If there is gonorrhea the gonococci may not be found, but the complement fixation test is positive.

Rectal palpation of the chronically inflamed prostate may reveal absolutely no abnormalities. As a rule, however, the acute inflammation has been sufficiently severe to leave palpable changes in and about the gland. The lobes may be tense and firm and bulging or soft and boggy. In the latter event massage will express from the lateral lobes a considerable quantity of purulent secretion. The pus gradually disappears, but the lobes usually remain permanently boggy.

The sclerotic changes about the gland resulting from parenchymatous prostatitis are felt as hard lumps on the surface of the lateral lobes or more frequently along its lateral borders and above it in the region of the apices of the vesicles. These "prostatovesicular" indurations are outside of the gland and cannot be rubbed away. They gradually subside in the course of many months, but are not likely to disappear completely.

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[1] *J. Urol.*, 1927, xviii, 293.

These periprostatic indurations sometimes suggest carcinoma of the prostate (Chap. XXXVIII) or tuberculosis (Chap. XXXI).

Prognosis.—As already stated, the prostate once severely inflamed is not likely to become wholly normal. The boggy lobes may sometimes but not always be rubbed free of pus, but they remain somewhat soft. The periprostatic indurations subside spontaneously to small hard lumps. The symptoms disappear. But even if the pus has entirely disappeared from the prostatic secretion a few rubs will bring it back. Such prostates need no treatment except sexual hygiene.

Why some prostates become sclerotic to the point of obstructing urination and some do not is not clear. The severest and most chronic prostatitis does not necessarily lead to sclerosis and patients with sclerotic prostates do not necessarily give a history of a severe acute attack, though, as a rule, sclerosis is the outcome of prolonged inflammation.

Treatment.—The treatment of acute prostatitis is by heat and protection from trauma, of subacute prostatitis by prostatic massage, of chronic prostatitis by sexual hygiene.

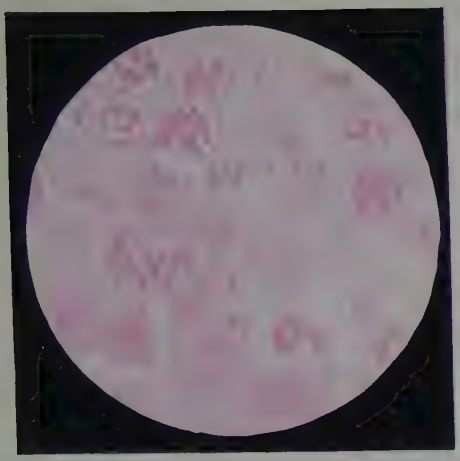
One often speaks of massaging the prostate; but it is prudent, in view of the fact that the vesicles may be inflamed even when they feel normal, always to massage the vesicles first and then the prostate, no matter which organ feels the most diseased, though paying most attention to obviously diseased regions.

The question whether these organs should be massaged severely or gently cannot be decided academically. A physician who rubs so hard as to make many of his patients faint loses many a case before it can be cured; and, on the other hand, the physician who massages too gently fails to cure certain cases that require severe rubbing. The intelligent practitioner will rub gently at first and increase the severity of the manipulation up to the point of the patient's endurance, and with an eye to the results obtained. Severe massage may do physical harm by exciting acute prostatitis, vesiculitis, and epididymitis. Mild massage very rarely does this. No two physicians massage with precisely the same method or with precisely the same severity, as patients are quick to note.

The patient, his bladder distended with urine or a mild antiseptic, leans over at right angles with his toes turned in. The operator then inserts the index finger, protected by rubber glove or cot and well lubricated, into the bowel, at the same time making counterpressure with the left hand on the patient's left shoulder. The finger is introduced as far as it will go. The firm prostate is identified and above it on each side the vesicular region.

The best method is to begin massage on one vesicle, reaching up as far toward its fundus as possible, to press upon it and then withdraw the finger in a zigzag way until one reaches the prostate. This maneuver is repeated half a dozen times and then the same treatment given to the opposite vesicle. If the vesicles are impalpable, this is enough. If distended or indurated, the maneuver should be repeated often enough to make a distinct reduction in their size, if the patient can bear so much manipulation.

The finger is then brought down to the prostate. Hard, angular indurations



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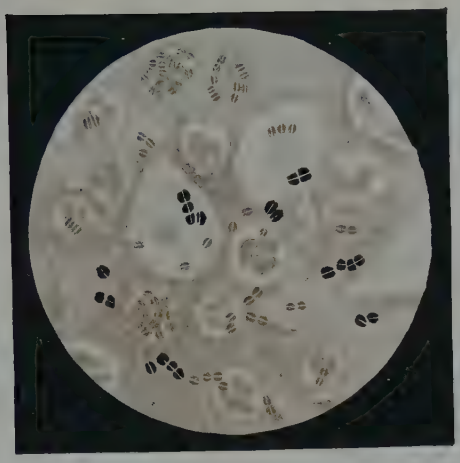

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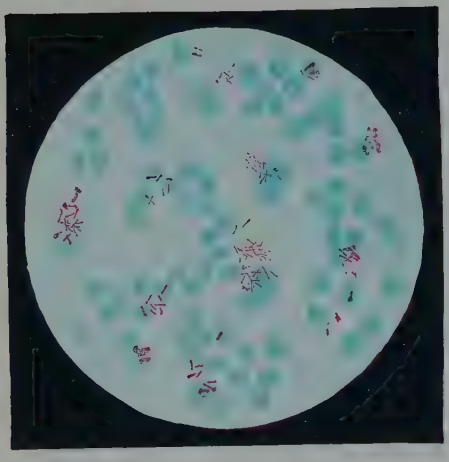

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PLATE IX.—MICROPHOTOGRAPHS OF GONOCOCCI AND TUBERCLE BACILLI.

Fig. 1.—Gonorrheal pus. First stain: gentian-violet solution.

Fig. 2.—Gonorrheal pus. Bismarck-brown. Cells and gonococci take the brown stain, while the pseudogonococci remain black.

Fig. 3.—Tubercle bacilli in urine.

Fig. 4.—Smegma bacilli in urine.

in and about this organ had best be avoided, and pressure made chiefly upon the more yielding portions of the gland. Beginning with one lobe, pressure is made upon it either with a to-and-fro lateral sweep of the finger or with a circular motion. This manipulation, if gentle, may be continued for one minute; if severe, half a dozen strokes may suffice. The same treatment is given the opposite lobe of the gland, and the manipulation concluded by a half dozen strokes over the prostatic sinus for the purpose of emptying the main ducts into the urethra.

Any extruded secretion is caught upon slide. After the massage the patient empties his bladder. The operator notes and examines microscopically the floating vesicular secretion and the sinking prostatic secretion.

Massage should not be repeated oftener than twice a week.

Massage of the prostate and seminal vesicles has been the fashion since advocated by Fuller a generation ago. Yet most massage does not the least good. Its use must be based upon the following considerations, which apply to the vesicles as well as the prostate, though it is convenient to speak only of the latter.

The prostate and vesicles are sexual organs and produce the bulk of the seminal fluid. While acutely inflamed their function must be held in abeyance, for an emission is a deleterious trauma. But as soon as the inflammation becomes chronic, resumption of their normal function is the basis of cure. Social considerations commonly interfere with carrying this precept out in practice. So long as gonococci linger and unless the patient is married, cohabitation may not be advocated. But that should not blind us to the fact that sexual starvation or gluttony are as bad for the chronically inflamed sexual organs as constipation and gluttony are for the chronically inflamed digestive organs.

Now one of the things that massage does is to fill this breach between sex hygiene and social hygiene. But it does this inefficiently. A constipated movement of the bowels will often squeeze out more semen from a boggy prostate than any finger can. A seminal emission is never so small as the few drops extruded by massage. Yet, for the period between the subsidence of acute gonorrhea and the return to cohabitation, massage is the best alleviation we have to offer for the treatment of chronic prostatitis and vesiculitis. As soon as the acute symptoms subside massage may be profitably begun.

At this time the prostate is usually still tense and perhaps obscured by an enveloping inflammatory edema. Within a few weeks, however, unless irritated by unusual sexual stress, the tense prostate becomes normal to rectal touch or boggy, the edema is absorbed or changes into scattered areas of induration which commonly lie along the borders of the prostate and at the apices of the seminal vesicles. The gonococci usually disappear within a month or two.

For purposes of treatment, bogginess should be considered as existing within the prostate and vesicles, indurations as periprostatic, perivesicular. If really chronic, of more than three months' duration, massage has little influence over either condition. Massage such a patient for a couple of years and he will

usually end about as he started. But sexual hygiene will relieve the bogginess if anything will. This and the lapse of time will reduce induration to a minimum. The more chronic the lesion the less it will be benefited by massage.

What then can be done for chronic lesions that do not get well under sexual hygiene? In the first place, investigate the sexual problem a bit further.

As a very simple example let me cite the case of a handsome big youngster who came to my office with a boggy indurated prostate, pus, perineal pain. He stated that prostatic massage helped a lot. I found it did, for without it he complained of much pain. He confessed to cohabitation once a week. I massaged vainly for about a month before I waked up.—"How many times do you cohabit every Sunday?" "Oh, about three times."

Chronic prostatitis is often not curable. The effort to free the prostatic secretion from all pus is vain. Sexual hygiene accomplishes more than massage and habitually reduces the pus to such an extent that it no longer is found in clumps under the microscope. No more need be required.

The object of massage is to bring the contour of the lobes back to normal and to reduce the amount of pus in the prostatic secretion. Progress should be estimated by occasional examinations of the prostatic secretion under the microscope. If the gland is quite actively inflamed the secretion seems a mass of pus, as improvement progresses the small shiny lecithin bodies begin to appear amid the clumps of pus, then the clumps grow fewer and finally disappear. Further progress is estimated by comparing the number of pus cells with the number of lecithin bodies in a field of the microscope. When the lecithin bodies predominate, it is time to desist and to depend for further improvement on sexual hygiene. Massage is repeated at longer intervals as a check on progress, but the months of massage to which patients are subjected in the hope of ridding them of the last pus cell are time wasted. Remember that if the patient has prostatorrhea each constipated movement expresses far more secretion than the most vigorous massage. Massage is a poor substitute for the normal ejaculation.

The ideal sexual hygiene is exemplified by the life of the unemotional man long happily married. He has sexual intercourse only when his vesicles are distended. He does not repeat. He does not withdraw. His sexual acts have not the character of a spree or of a competition. Every patient with chronic prostatitis, as soon as his gonococci have disappeared, if ever they were present, should aspire to this ideal. If he is unmarried it is an unattainable one.

The treatment of prostatic sclerosis is considered in connection with prostatism, of which it is one type.

VESICULITIS

Acute infection of the prostate doubtless always invades the seminal vesicles by way of the utricle and the ejaculatory ducts. One should think of prostatovesiculitis just as one thinks of nasopharyngitis. But chronic infection, dependent upon bad drainage, may persist in one or the other gland.

Pathology.—The changes caused by acute infection of the seminal vesicles are similar to those in the prostate, with this exception—that the vesicle is a gland of so much larger caliber and with so much larger a duct that recognized abscess in it is uncommon, and its infection, if unaccompanied by dilatation, is often overlooked.

The walls of the chronically inflamed vesicle are infiltrated and matted together in what is pathologically a perivesiculitis. This may or may not result in palpable enlargement. The mucosa is infiltrated and eroded. The lumen is in places contracted or occluded by stricture, in others dilated. This dilatation can be demonstrated by injection into the vas (Fig. 54). In long-standing cases the vesicle may be changed from its normal state—a branching ramifying canal—to an irregular cavity containing several c.c. of pus. Chronically inflamed vesicles have been appropriately termed by Belfield "pus tubes in the male."

FIG. 54.—INJECTION OF BOTH VASA IN THE GROIN.

The right vas is occluded. The left vas and vesicle are injected and some of the injected fluid has overflowed into the bladder. (Rolnick)

Vesiculitis is always bilateral, often impalpable.

The secretion of the normal vesicle varies in consistency from thick gelatinous to sticky and ropy. The microscope shows mucoidal masses entangling spermatozoa, sympexia, and epithelial cells. The color is usually opalescent, but may be rusty, especially in older persons, from pigmentation of the contained epithelia. When spermatozoa are absent Boettcher's crystals are usually found. The vesicular secretion floats, in part, in water, whereas the prostatic secretion sinks.

The secretion of an inflamed vesicle contains pus and bacteria. Live spermatozoa are sometimes, though not often, found in purulent vesicular secretion.

Symptoms.—Acute seminal vesiculitis usually gives no subjective symptoms. Rectal touch may detect nothing or it may reveal distention, tenderness, perivesicular edema.

Abscess of the vesicle is extremely uncommon as a clinical entity. I have seen but one chronic abscess of the vesicle which I drained through the ischiorectal fossa. But cases have been reported of acute suppuration, driven upward by fascia of Denonvillier and bursting into the peritoneum. Acute nongonorrheal vesiculitis occasionally spreads to the surrounding cellular tissue, causing a retrovesical pericystitis which may occasion a few days of fever and is identified by rectal touch as an irregular infiltrate above the prostate, edematous at first, later of a wooden hardness suggesting carcinoma. The local and reflex symptoms of such a condition are those of chronic vesiculitis.

There is a type of acute seminal vesiculitis due to sustained and suppressed

sexual excitement of which the symptoms are hemosperm and painful ejaculation. Acute bacterial infections do not cause hemosperm.

Chronic seminal vesiculitis, like chronic prostatitis, is usually symptomless. Moreover, the discrepancy between the findings of rectal examination and the presence or absence of symptoms or even of vesiculitis is most confusing. The examination may reveal indurations about a vesicle that has long since ceased to contain pus; a distended vesicle may contain only a normal secretion, and I have proven both of these facts when I was doing vesiculectomies for arthritis. An inflamed vesicle may be quite impalpable.

Distention of the vesicles suggests ancient suppuration or suppressed sexual strain. Indurations about the vesicles prove that they have been inflamed.

The symptoms attributed to vesiculitis may therefore be accepted under suspicion. They may be classed as: Local pain, referred pain, surface extension of infection, metastatic infection, sexual symptoms.

The local pain due to vesiculitis is usually an ache or sense of fullness and discomfort up the rectum, radiating to the back, the perineum, the testes, the thighs. This is only felt when the vesicle is acutely inflamed or overdistended.

No man who has been young will deny that the commonest referred pain from the vesicle is an ache in the testicle. But this ache of sexual strain is rarely reproduced by infection. It is not clear whether vesiculitis, deferentitis or mild chronic epididymitis is the cause of "neuralgia" of the epididymis. Massage of the vesicle sometimes alleviates this pain, oftener it does not. Sacro-iliac pain and renal colic are sometimes caused by vesiculitis.

Vesicular colic is a sharp grinding pain up the rectum, usually occurring at night and recurring at irregular intervals, somewhat related to sexual strain. It is relievable by rectal irrigation with hot or cold water, curable by massage.

"Cystitis" may be due to vesiculitis. This is most commonly seen after prostatectomy, when irritability of the bladder persists in spite of the relief of retention, and rectal touch reveals retrovesical pericystitis. It may be relieved by vesiculectomy. Sir John Thompson-Walker devised his transvesical vesiculectomy for the relief of this condition.

Stricture or spasm of the lower ureter has been attributed to extension of infection from the vesicle to the lower end of the ureter. This point of contact between the genital and the urinary channels is also accused of transmitting tuberculosis from the one to the other.

Posterior urethritis and prostatitis may be kept alight by vesiculitis, if we may judge from the fact that Belfield's operation of vas injection relieves these conditions, as indeed it does. I have performed but few Belfield operations because such testimony as I can gather from urologists in the section of the country where this operation flourishes divides these men into two camps, viz., those who do the operation frequently and those who do not do it at all. The former state that it does not cause sterility, the latter that it does. Now Chetwood twenty-five years ago tied off the vasa to prevent relapsing epididymitis and, following this practice, I have noted that after vasotomy chronic intractable

posterior urethritis and prostatitis may be expected to subside. I therefore prefer vasotomy to Belfield's operation and believe that much of the benefit attributed to the latter may be due to the obstruction of the lumen of the vas, though why, is not clear.

The attribution of relapsing epididymitis to chronic vesiculitis has been mentioned. Acute epididymitis is always accompanied by vesiculitis and may be looked upon as an extension of this.

Painful ejaculation due to inflammatory obstruction of the ejaculatory duct and hemosperm, as mentioned above, are the sexual symptoms most clearly attributed to the vesicles. Although vesiculectomy has occasionally been followed by impotence due to complete failure of erection, this is not the rule. It is not clear in how far the symptoms of impotence or of sexual psychasthenia are attributable to chronic vesiculitis.

Fuller, the first American to interest himself in vesicular infections, evolved the theory that gonorrheal rheumatism in men is usually due to vesiculitis. His theory was founded upon experience with the chronic arthritic indigent New Yorkers who reached the City (then Charity) Hospital. Having massaged their vesicles in vain he developed an operation of vesiculotomy to which he attributed the cure of many of his patients. Many years thereafter Young, Cunningham and Squier manifested enthusiasm for vesiculectomy, or vesiculotomy. As Young says in his book, "The results obtained by vesiculotomy or vesiculectomy are often immediately brilliant. We have seen some of the most extraordinary chronic joint infections disappear like magic but, unfortunately, in many cases the results are not so satisfactory and in some cases entirely disappointing."

I have done very few vesiculotomies, still fewer vesiculectomies. My hospital associates have at times been more enthusiastic than I. From this combined experience it appears that there is no evidence to justify operation upon the vesicles for the relief of gonococcic arthritis. A large proportion of the vesicles removed showed no pus in their secretion. Striking relief was only obtained in the very chronic cases of non-gonococcic arthritis. Vesiculectomy does not prevent the patient from having arthritis with his next attack of gonorrhea. I have seen this happen.

Young says, "Intravenous mercurochrome often gives wonderful results in vesiculitis."

Diagnosis.—The discovery of pus in the secretion expressed from the vesicle is the only absolutely sure evidence that it is inflamed. This evidence is not easy to get. When the vesicles are acutely inflamed the diagnosis is based upon the changes palpable in and about them. One does not massage the vesicle for fear of exciting epididymitis.

But, as stated above, the chronically inflamed vesicle is not always palpably diseased; the palpably diseased vesicle may no longer be inflamed. The distended vesicle is perhaps merely full of semen.

Therefore many tests have been devised, such as those of Pedersen and Wolbarst, requiring that the patient's bladder be filled with boracic acid solution

and that he empty it into five to seven glasses, the first two representing the urethral and bladder washings, the others being passed after fractional massage of the prostate, for the third glass, and each vesicle for the fourth and fifth. The well-known contamination of the last squirt of urine by the expression in it of some prostatic or vesicular secretion invalidates the absolute accuracy of these tests, yet if not taken too precisely, they do suggest the distribution of any active chronic inflammation. But what we know of the prostate is doubtless true of the vesicles, *i.e.*, that they are at first simultaneously infected and that though this infection subside to the point of showing no pus cells in the expressed secretion, yet usually it persists. Hence, while examination may suggest, and the results of treatment after a fashion prove, the location of the infection, one should always retain a certain skepticism as to cure.

Treatment.—Most cases of vesiculitis subside without diagnosis and without treatment. When either prostate or vesicles are considered sufficiently inflamed to require treatment, this is given by means of massage. When any of these organs is considered to require massage, the treatment should be applied to all of them. The chronically inflamed vesicle, like the chronically inflamed prostate, is relieved by sexual hygiene rather than by massage.

Intractable cases may be treated by Belfield's operation or by vasotomy without injection. Either operation is likely to make the patient sterile, a fact of which he should be informed.

That the advocates of vesiculectomy do not employ it for the relief of the symptoms commonly attributed to vesiculitis is an example of the confusion that reigns in our clinical analysis of prostatitis, vesiculitis and posterior urethritis.

Perivesiculitis usually subsides without drainage. If it is decided to drain a retrovesical abscess, this may be reached either from the perineum or transvesically, by the route of approach for operations upon the vesicles.

URETHRITIS

Inflammations of the urethra may be bacterial or non-bacterial. The non-bacterial inflammations may be again subdivided into those that may occur in the urethra not previously inflamed and those that occur only in the urethra that is scarred or catarrhal as a result of previous inflammation.

Gonorrheal urethritis is so much more common, so much more severe than any of the other forms of bacterial urethritis that it completely overshadows these in the mind of the practitioner. Actually, however, the urethra, like any other mucous membrane, may be inflamed by inoculation, by extension of inflammation from adjacent tissues, or by metastasis.

Inoculation urethritis is usually gonorrheal (Chap. LXXII *et seq.*). The urethra is relatively immune to infection by the pyogenic bacteria and the resulting inflammation is so slight that it is rarely noted. I have only once or twice cultivated the same cocci, not gonococci, from man and wife. Ure-

thritis by inoculation from leukorrheal discharges, or acquired from a woman who has just ceased menstruating is usually gonorrheal.

But the usual non-gonorrheal inoculation urethritis is the urethritis of disuse. This is seen after suprapubic cystotomy as a mild inflammation, characterized by no pain, but only a purulent discharge in which are found staphylococci or streptococci or bacteria of the colon group. It clears up spontaneously when micturition is resumed. It is also seen as a profuse discharge alongside the indwelling catheter. This disappears when the catheter is withdrawn, though a mild prostatitis is likely to persist.

Urethritis by extension, pyogenic or tuberculous, usually originates in the prostate. It may also extend from the ureter by way of the trigone.

Urethritis due to sexual excess is primarily a prostatitis.

Traumatic urethritis is due to rough passage of instruments, urethral stone or foreign body, cauterizing injections.

Metastatic urethritis, such as the alleged gouty and rheumatic urethritis, doubtless only occurs in a canal damaged by previous inflammation.

Urethritis due to the excretion of irritating substances in the urine, *e.g.*, cantharides, turpentine, arsenic, potassium iodid, is a trivial affair.

The lesions of acute and chronic urethritis, and its pathological complications are so intimately associated in our minds with the gonococcus that their description is given in that connection. Suffice it to say here that these lesions are catarrhal, with a tendency to chronicity due to retention of pus and bacteria in the glands, and a resulting sclerosis in the form of stricture.

The striking difference between gonorrheal urethritis and the inflammation due to other bacteria is that the gonococcus infection originates at the meatus; whereas most of the others begin in the prostate; it is more intense and gives rise to a greater variety of complications.

The only symptom of non-gonorrheal urethritis, as such, is a discharge of pus from the meatus. To this may be added the symptoms of the complications, notably those of prostatitis and epididymitis. The characteristic symptom-complex of acute gonorrhea is not seen.

Diagnosis.—To diagnose the existence of urethritis is no great triumph. To distinguish its cause with sufficient acumen requires the widest experience. Interest centers about those types of inflammation that may be misinterpreted for gonorrhea. Such are:

The various forms of urethritis arising in the prostate, viz., postgonorrheal prostatitis, tuberculous prostatitis, and the infections due to influenza, typhoid, and other general infections.

Urethritis due to sexual irregularities or excesses, and this too is predominantly prostatic.

Urethritis due to recurrence of inflammation in a patch of unhealed gonorrheal infiltration of the anterior urethra, which is therefore actually a symptom of stricture.

Urethritis due to syphilis, in the form of chancre, mucous patches, gumma;

and this is distinguished by the positive Wassermann reaction, and the presence, sometimes, of a palpable lump at the site of chancre or gumma.

Herpes of the urethra, which is associated, either simultaneously, or at a short interval of time, with herpes of the glans penis.

Urethritis due to leukoplakia, a very mild chronic affair, diagnosed by the urethroscope, which distinguishes the characteristic white, hard, papillary lesion of leukoplakia.

Apart from these varieties, one occasionally encounters acute mild urethritis, apparently due to infection with Gram-positive cocci, unassociated with any prostatitis or infiltration of the urethra, and seemingly due to infection in coitus. This can only be distinguished from gonorrheal urethritis by repeated vain search for the gonococcus.

The correct diagnosis of urethritis will depend upon an insistent suspicion of gonorrhea, careful history and physical examination, and a realization that the lesion may be due to a combination of causes, including especially antecedent gonorrhea, sexual excess, unsuspected chronic prostatitis.

The commonest causes of an acute outbreak of non-gonorrheal urethritis are alcoholism and sexual excesses. There is usually an antecedent urethral lesion in the form of an infiltration left by gonorrhea of the anterior urethra—which may be detected by the bulbous bougie—or a chronic prostatitis.

The diagnosis of the seat of the lesion, whether in the anterior or in the posterior urethra, by the two-glass test, is described in Chapters II and LXXV.

Prognosis.—The prognosis as to complications during the acute non-gonorrheal urethritis, and as to stricture resulting from it, are both good. The acute attack is too mild to promise periurethral abscess. If stricture is detected by the bulbous bougie, it probably preceded the urethritis and was its underlying cause.

Yet non-gonorrheal urethritis is notoriously hard to cure in spite of its mildness. This chronicity is usually due to prostatitis and is attributable to the very causes that occasioned the urethritis, be they general or sexual.

Treatment.—The treatment of acute non-gonorrheal urethritis must be conducted on pragmatic principles. No therapeutic principle or clinical conviction should interfere with alert observation. The correct treatment is the treatment that works. It is never twice the same because the causes of the catarrh are never twice the same. Only the cure of the infection can fully eliminate the possibility of prostatitis or stricture or the presence of gonococci.

In most instances the discharge is so slight at first that no local treatment is given during the first few days lest the search for gonococci be interfered with. During this time we give internal treatment; hexamethylenamin if the presence of albumin suggests pyelonephritis, restriction of fluids and administration of sandalwood oil if there is none. Meanwhile we determine whether we should massage the prostate by repeated two-glass tests and rectal examinations.

If the attack is a mild one or due to causes that have ceased to act, such

as acute alcoholism, the discharge ceases during this tentative period. If shreds of pus persist in the urine we discover the presence of stricture, prostatitis or chronic posterior urethritis (see below) and treat them. If the urine becomes perfectly clear, we dismiss the patient with an admonition to mend his ways.

If the discharge persists, it is attacked by irrigation of the anterior urethra with potassium permanganate, 1 : 5,000, once a day, or an experienced patient may inject 1 : 200 zinc sulphate, twice a day. If this does not promptly control the discharge, we pass a catheter to test for residual urine and to get the benefit of gentle massage of the urethra, and through it fill the bladder with silver nitrate or potassium permanganate, 1 : 5,000, once a day, and massage the prostate twice a week, if this is inflamed.

If this fails, we pass a 24 F. sound very gently twice a week in addition to the irrigations. If this increases the discharge, we suspect gonorrhea.

If local treatment irritates, we desist, force fluids; after a week try argyrol, 10 per cent, or acriflavin, 1 : 2,000, injections.

If local treatment neither irritates nor cures, we pass the posterior urethroscope for diagnosis and treatment.

POSTERIOR URETHRITIS

Inflammation of the posterior urethra, if due to infection, is accompanied by inflammation of the prostate. But posterior urethritis due to sexual strain centers about the verumontanum and often does not involve the prostate. Chronic posterior urethritis may persist after the cure of the prostatitis, though more often the prostatitis outlasts the urethritis.

We think of posterior urethritis in terms of the prostatic urethra. The membranous urethral glands are so relatively insignificant that involvement of this part of the urethra in an infection is of no great importance. The only notice taken of the membranous urethra by the clinician is to look there for inflamed gland orifices, as he withdraws the urethroscope, or to note its implication in stricture.

The lesions of acute posterior urethritis have no clinical interest as compared to those of the acute prostatitis which they accompany. If an abscess occurs in the urethral glands or in the utricle it passes for prostatic abscess.

The lesions of chronic posterior urethritis may be classified as (*a*) diffuse lesions, (*b*) granulomata, (*c*) cysts, (*d*) deformities due to operation or to discharge of prostatic abscess, (*e*) verumontanitis and utriculitis.

The diffuse lesions are seen by urethroscopy chiefly on the surface of a sclerotic bladder neck. The mucosa is irregularly swollen and edematous, red and readily eroded.

The granulomata are exuberant granulations, wartlike projections that may occur in any portion of the prostatic urethra, but are most commonly seen on the floor in the region of the verumontanum.

The cysts are usually small and multiple. They cluster about the bladder

neck. They are much larger and more closely packed together than the cysts of cystitis cystica. They are often associated with prostatic sclerosis. They are doubtless retention cysts.

Larger cysts occur singly, usually projecting into the bladder from the upper part of one lateral lobe of the prostate. They cause obstructive symptoms and are not clinically related to infection.

Inflammation of the verumontanum is doubtless symptomatic of utriculitis. Rytina [2] has studied the relation between the two and has practiced irrigation of the utricle when he found its contents purulent. He also amputated the inflamed verumontanum and found it the seat of periacinous and submucous infiltration. Inflammation of the verumontanum is generally regarded as a lesion apart, due to sexual rather than to infectious cause, and resulting in derangements of the sexual function.

Symptoms.—The acutely inflamed posterior urethra discharges so much pus into the urine that it fills the posterior urethra and flows back into the bladder, contaminating the urine therein. Let the patient pass his urine into two glasses, both will contain pus, though if no more than 10 c.c. have been passed into the first glass, this will be the more cloudy.

The milder acute infections give no subjective symptoms. But if the infection is severe it invades the prostate and occasions that exquisitely painful, urgent, frequent urination already described as a cardinal symptom of acute prostatitis and usually spoken of as acute posterior urethritis.

In non-gonorrheal cases the anterior urethra is usually sufficiently inflamed to occasion a discharge of pus from the meatus. In gonorrheal cases the anterior urethra is already inflamed.

The symptoms of chronic posterior urethritis are (*a*) catarrhal, (*b*) sexual, (*c*) those of the accompanying prostatitis and vesiculitis.

The catarrhal symptom is the discharge of pus and pus shreds in the urine. The pus is usually present in no great quantity and does not fill the prostatic urethra and flow back into the bladder; it appears in the first gush of urine passed. The shreds are masses of pus and desquamated epithelia gummed together in fibrous masses. These come from the inflamed surface of the urethra or from the granulomata and are therefore small and threadlike in comparison to the shreds that are derived from the more extensive ulcerations of chronic anterior urethritis. Large shreds from the posterior urethra mean an unusual lesion, such as tuberculosis, tumor, an unhealed operative wound or sinus from a prostatic abscess. There is habitually a slight urethral discharge.

The sexual symptoms belong characteristically to the patients whose posterior urethral lesion is due to sexual irregularities, causing verumontanitis. But such patients may have a posterior urethritis due to gonorrhea or other causes as well. It is a matter of the greatest difficulty to disentangle symptoms due to a lesion, whether of the prostate, the vesicles or the verumontanum, from those of purely psychic origin. It is my impression that whatever the cause of the

[2] *J. Am. M. Ass.*, 1915, lxiv, 45.

sexual symptom, be it lack of erection, premature ejaculation, painful ejaculation, pain in the perineum, in the testicle, in the sacrum, the patient who consults the urologist for the relief of this symptom almost invariably, and often quite rightly, attributes it to some sexual stress or misdemeanor which he may be quite unwilling to confess. Consequently the patient is a potential psychasthenic and not infrequently the inadvertence and carelessness of the first urologist who sees him fixes this especially if he perceives only the physical situation, looking upon the patient as a neurotic, using him as willing material for the torture of a demonstration of urethroscopy, etc. After this if the patient is a clinic case, ignorant, emotional, a foreigner, he cannot be cured. Even the educated patient will require time to recover from the shock.

Such being the case, the urologist in attacking any of the sexual symptoms attributed to physical lesions must constitute himself three parts psychiatrist.

The physical character of the sexual symptoms due to verumontanitis is varied; premature ejaculation and the train of sequent symptoms, loss of erection, absence of ejaculation, painful ejaculation—which Rytina attributes to sinusitis—discomfort in the perineum of various types (some are uneasy on a soft seat, some on a hard one, some are more comfortable when walking about, others when still) and various reflex pains such as have been enumerated as symptomatic of prostatitis and vesiculitis.

Treatment.—Amid this confusion only time and careful management with due regard for the patient's psychic state can determine what is the proper treatment.

One begins with a complete physical and psychic examination, with the exception that the urethra is explored only to that degree which the patient can bear without too much psychic shock. Discomforts are attacked by hot sitz-baths and hot rectal irrigations, palpable lesions in prostate and vesicles by massage, the patient's sexual history by analysis of as practical a sort as possible.

The first urethral instrumentation is preceded by novocain and consists in the gentle passage of a catheter to determine the presence of residual urine and to test the patient's sensitiveness.

Gonococci are searched for by smear, by urethral culture and by complement fixation.

Having satisfied one's self that gonococci are absent and that urethroscopy will not unduly shock the patient the urethroscope is introduced and the lesions examined and treated as described in Chapter V.

CHAPTER XXI

STRICTURE OF THE URETHRA: ETIOLOGY, PATHOLOGY, SYMPTOMS, RESULTS, DIAGNOSIS

True organic stricture of the urethra is a cicatrix of the urethral wall left there by some injury or inflammation, and manifesting a constant tendency to contract, and thus to diminish the lumen of the urethra. This tendency to contraction is doubtless caused by the irritation incident to micturition, the impact of the stream against the barrier; for the deepest stricture, the one that most obstructs the flow of urine, is almost always the tightest, and if the stricture is kept dilated so as to afford little or no obstruction, the tendency to recontraction is usually slight. Yet the inherent cause of the contraction is the elasticity of scar tissue. Neglected stricture contracts.

Stricture occurs in the female as well as in the male urethra. But this lesion in the female is much less common than in the male, and manifests no distinguishing peculiarities, either in pathology, symptoms, diagnosis or treatment.

Oberlaender refused to recognize any pathological distinction between chronic anterior urethritis and stricture. The pathological difference is only one of degree; chronic urethritis is the scar-forming inflammation. Stricture is the inflamed scar that results.

VARIETIES

Strictures may be classified from several points of view: thus, for prognostic purposes, strictures are considered as anterior, external to the bulbous urethra, and posterior beyond this point; therapeutically considered, strictures are of large caliber, admitting a 20 F. bulbous bougie, or of small caliber; while from a pathological and etiological point of view strictures are classified as inflammatory and traumatic. The old descriptive division into linear, annular, and tortuous or irregular stricture is clinically convenient to describe the nature of the obstruction to the exploring instrument, and the terms soft, fibrous, and inodular, or indurated, are descriptive of important features.

ETIOLOGY

All true strictures are either inflammatory or traumatic, and most inflammatory strictures are gonorrheal.

By far the greater number of strictures are gonorrheal. Thus out of 220

cases studied by Thompson, 164 (75 per cent) owed their origin to gonorrhea; while Martin found among 219 cases 187 gonorrheal strictures (85 per cent). My office case books record 583 gonorrheal to 43 traumatic strictures.

The *causes of gonorrheal stricture* are, however, many. The inflammation itself usually causes the stricture; but it is difficult to estimate what proportion of strictures is due to breaking a chordee, to a false motion in coitus causing a tear in the inflamed mucous membrane, to the ill-advised use of caustic injections for the purpose of aborting the attack, or to the injudicious use of instruments in the urethra before the attack has subsided. Such strictures are properly traumatic, since trauma of the same kind, but greater in degree, may cause stricture when the mucous membrane is not inflamed and the gonorrhea thus only plays the rôle of a predisposing cause.

There is a small class of *intermediate cases* in which the stricture is inflammatory but not gonorrheal. To this class belong strictures caused by urethral chancres [1] and ulcerations, or loss of substance from periurethritis, etc. Slight strictures may result from non-gonorrheal urethritis.

The *causes of traumatic stricture* vary widely. The penile portion of the urethra may be divided by knife or bullet, or torn by bending the erect penis, by a false motion in coitus, or by breaking a chordee. The bulb is the portion usually affected by trauma from within, by ulceration from stone, foreign body, or retained catheter, or by the sharp point of a blundering instrument. The prostatic urethra becomes strictured when torn by disruption of the pelvis. Stricture at the bladder neck is the result of chronic prostatitis.

But of all traumatic strictures, stricture at the junction of bulb and membranous urethra is the most frequent. The stricture is caused by a crushing force applied to the perineum, which brings the urethra sharply into contact with the subpubic ligament, crushing it beneath the sharp edge of this structure or tearing away from it in front.

The injuries which have caused traumatic stricture in the perineum, with or without a penetrating wound, are innumerable. They may be summarized in the term "straddle injuries." They may be overlooked by the patient if they do not give rise to immediate hemorrhage or retention. Yet in after years symptoms of stricture come on, and the canal is found tightly contracted at its membranous portion.

Pathogenesis of Inflammatory Stricture.—Chronic urethritis is essentially a sclerotic process, characterized by deposits of cicatricial tissue in the submucosa and even in the corpus spongiosum. But the intensity of the stricture depends upon the virulence of the urethral inflammation. The more severe the initial attack, the more intense the chordee, the more frequent and violent the relapses, and the longer the gonococcus can be found in the discharge, the greater is the probability of stricture. Mild chronic urethral inflammation is neither deep-seated nor productive of any permanent scar; while the acute inflammation,

[1] Ten cases of diffuse urethral syphiloma have been reported. *Guyon's Annales*, 1898, xvi, 892.

with its involvement of the lacunæ and glands, its circumscribed or diffused areas of periurethritis, is the inflammation calculated to leave behind permanent scars in and beneath the mucous membrane.

In this connection *the time of occurrence of stricture after gonorrhea and injury* is of interest. Of the 164 cases of stricture following gonorrhea, tabulated by Thompson, in 10 symptoms appeared immediately after or during the attack; 71 within one year; 41 between three and four years; 22 between seven and eight years; 20 between eight and twenty-five years. I found among 212 cases of gonorrheal stricture 121 cases within the first year, 65 distributed between the second and tenth years, and 26 after the tenth year. On the other hand, I have seen an impassable stricture in the perineum six weeks after a severe injury, and Guyon has met a stricture which only admitted a 16 F. sound two weeks after injury, and another which would not admit a 12 F. after six weeks.

The deductions from the above statistics, confirmed by daily observation, are that the symptoms of stricture appear earlier after traumatism than after gonorrhea, the date of their appearance being measurably proportionate to the extent of the injury, and that the greatest divergence is noticeable after gonorrhea. It is totally exceptional, however, for symptoms of organic stricture to come on immediately after or during the attack of gonorrhea—as Thompson states occurred in ten of his cases—unless stricture existed previous to the attack, unnoticed by the patient.

PATHOLOGY

Number of Strictures.—While Thompson, in examining 270 pathological specimens, found only 44 cases of multiple stricture, Guyon lays down the clinical rule that gonorrheal strictures are multiple, while traumatic strictures are single. These statements, properly interpreted, conform perfectly with each other and with the facts. Concerning traumatic strictures, there is no doubt; they are almost always single. But gonorrheal strictures, while frequently single from the pathologist's point of view, often present a number of ridges to the examining sound. Clinically, therefore, gonorrheal strictures are often multiple, pathologically they are usually single.

Seat of Stricture.—Thompson divides the urethra into three regions:

1. The bulbomembranous, including 1 inch in front of and ¾ inch behind the junction of the spongy with the membranous urethra.

2. From the anterior limit of region 1 to within 2½ inches of the meatus, embracing from 2½ to 3 inches of the spongy urethra.

3. The first 2½ inches of the canal from the meatus.

His 270 preparations showed 320 strictures: 67 per cent in region 1; 16 per cent in region 2; 17 per cent in region 3.

It is convenient to associate the region in which the stricture occurs with its cause. Thus, strictures at or near the meatus, if not congenital, are usually

caused by chancrous or chancroidal ulceration, less frequently by caustic injections and by gonorrhea. Strictures of the pendulous urethra are commonly gonorrheal. Strictures of the bulb and at the bulbomembranous urethra are also commonly gonorrheal. Strictures in the prostatic urethra may be gonorrheal or traumatic.

Form of Stricture.—The stricture is usually chiefly built up from the floor of the canal. This is most notable in the bulb, and commonly results in an eccentric position of the orifice of the stricture, close to the upper wall of the canal.

In the broad, irregular strictures that are clinically multiple, the constrictions become progressively narrower as they approach the bladder. Beginning, perhaps, at the penoscrotal angle, there is a constriction which admits a 20 F. sound. A short distance farther on this, too, is obstructed, and only a 15 F. will pass, and finally the stricture in the bulb admits only a filiform instrument. In other words, the deeper extremity of the stricture, which receives the strongest impact of urine, is more irritated than the rest and contracts more rapidly. A filiform stricture at the penoscrotal angle usually has a dilated urethra beyond.

FIG. 55.—CONGENITAL STRICTURE OF THE MEATUS.

A probe is inserted into the pocket behind the stricture. This is not an inflammatory stricture.

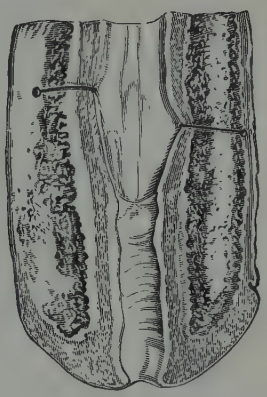

FIG. 56.—STRICTURE OF ANTERIOR URETHRA. (Voillemier)

Gross Pathological Changes (Figs. 56, 57, 58).—When the strictured urethra is slit longitudinally, the mucous membrane may be found only slightly thickened and congested. Or it may be cicatricial in character or covered with granulations. A band or a mass of cicatrix may replace the mucous membrane throughout its thickness, and may even penetrate the corpus spongiosum. This tissue may be slight in extent, cicatricial in character, tightly contracted; or it may be exuberant, knobbed, and excessive in amount so as to be readily felt from the outside of the canal. In this callous, fibrous mass there may be irregular areas of inflammation and suppuration. Behind the stricture the canal

is distended and more or less extensively ulcerated, and immediately in front of the stricture there may be lesser dilatations and ulcerations.

If the retention has been prolonged and grave the upper urinary organs show the results of retention and infection illustrated in Figure 58.

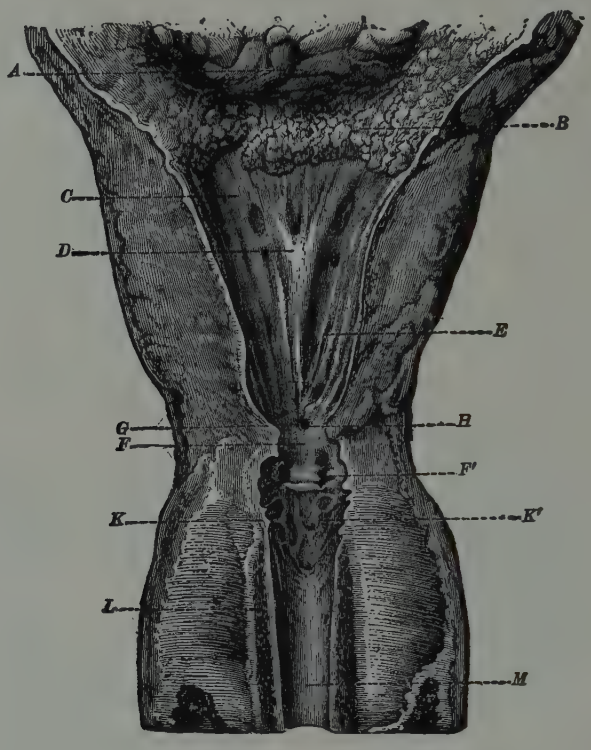

FIG. 57.—STRICTURE OF MEMBRANOUS URETHRA.

A, bladder; *B*, bladder neck; *C*, dilated prostatic urethra; *D*, verumontanum; *E*, one of the prostatic ducts; *F*, *G*, *K*, the stricture; *F*, dilatations in front of the tightest part of the stricture; *H*, orifice of small abscess cavity; *K*, mucous membrane in front of the stricture, thin and ulcerated; *L*, corpus spongiosum; *M*, anterior urethra. (Voillemier)

SUBJECTIVE SYMPTOMS

Organic stricture may exist for years, producing no symptoms and unsuspected.

The Onset.—Symptoms of inflammatory stricture occur within one year in over half the cases; though one-quarter of them show no symptoms until after five years have elapsed, and the onset may be deferred for fifteen years or even longer. But only one-third of my private cases submitted to treatment within a year of the beginning of their symptoms; another third within five years; and

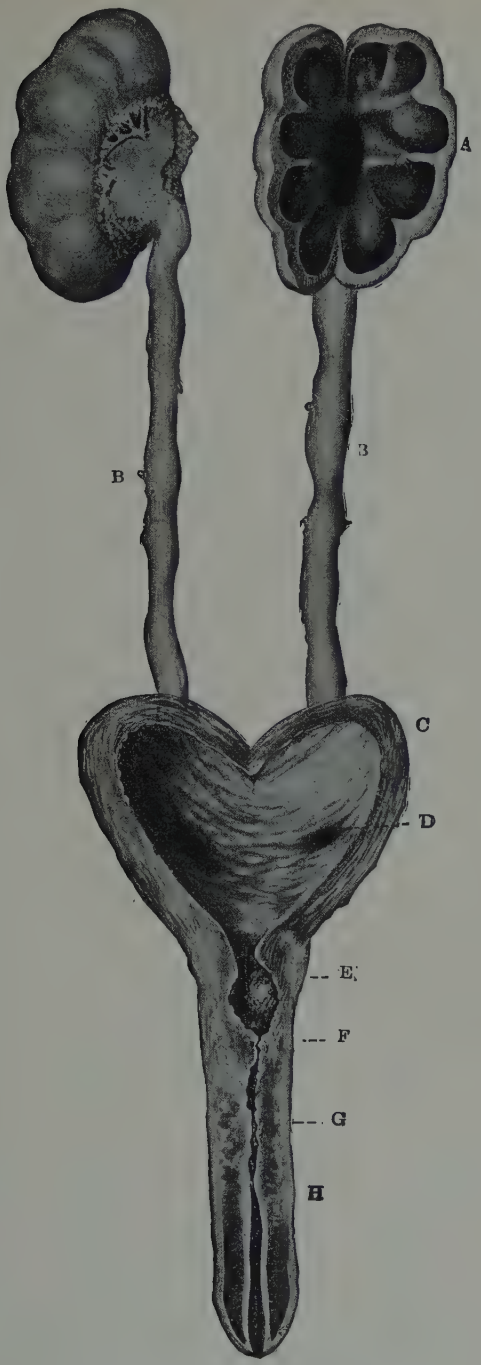

FIG. 58.—RESULTS OF STRICTURE.

A, A, Kidneys dilated, sclerosed, pyonephrotic; *B, B,* urethers irregularly dilated; *C,* bladder contracted and thickened (concentric hypertrophy); *D,* dilated ureteral orifice; *E,* prostatic urethra dilated (prostatic abscess); *F-H,* the stricture; *F,* its tightest point; *G,* corpora cavernosa involved in the scar.

one-seventh delayed treatment until their symptoms had existed for ten or more years.[2]

The initial symptom is usually the presence of heavy thick pus shreds and more or less free pus in the urine. If the stricture follows immediately after a gonorrhea the urethral discharge is perpetuated; but more often there is a lull while the shreds, and perhaps the general cloudiness of urine, persists, but, in the absence of a notable gleet, do not attract the patient's attention. The shreds and pus are evidence of the local inflammation on the stricture, which is adding fuel to the flame, and encouraging extension and contraction of the fibrous tissue beneath.

The Morning Drop.—As the stricture contracts the urethritis grows worse and, sooner or later, produces a moderate chronic discharge, perhaps only visible in the morning when the urethra has not been scoured by the urinary stream for eight hours, perhaps persisting throughout the day. This is *gleet*. It is usually the first symptom noted by the patient. The gleet of stricture gets better or worse according to the degree of acidity of the urine and the amount of sexual indulgence or of venereal excitement. Exacerbations of gleet from slight causes, or repeated attacks of gonorrhea, as the patient usually considers them, often constitute the most marked feature of the case. In fact, it is the rule in mild cases for the patient to be wholly unconscious that his urethra is at all narrowed. Gleet was the initial symptom of 238 of my cases.

Changes in the Stream.—As the stricture tightens, fresh symptoms are added. The gleet continues, the stream of urine is small and irregular.[3] The last few drops of urine are retained in the canal, both mechanically by the obstruction of the stricture, and because the wave of blood, impelled by the contraction of the accelerator urinæ upon the bulb in the final effort at clearing the canal, cannot pass along the corpus spongiosum, on account of the obliteration of its meshes at the point of stricture, and thus fails in its function of expelling the last few drops of urine from the canal. By this same obliteration of spongy tissue, erection is sometimes rendered imperfect and painful. Obstructed urination was the first symptom in seventy-seven of my cases.

Frequent Micturition.—Next to gleety discharge frequency of micturition is the commonest symptom of stricture. It is due to one or all of the following factors, viz., straining to overcome the urethral resistance, prostatitis, cystitis, polyuria due to renal congestion.

With the frequency there is more or less pain. This was the initial symptom in sixty-one of my cases.

Retention.—The congestion of the stricture may be kindled by a heavy dinner, a little excess in drink, or a chilling of the legs; the mucous membrane

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[2] *Tr. Am. Ass. Genito-Urin. Surg.*, 1915, x, 11.

[3] It is to be noted that while an impediment anywhere in a water-pipe (such as the urethra) modifies the *force* of the stream, the *shape* of the stream depends chiefly upon the shape of the nozzle (the meatus). Thus the shape of the stream, upon which so much stress is commonly laid, has no bearing on the diagnosis of stricture. It is modified by adherent pus at the meatus more often than by any other cause.

swells, the stricture closes, and acute retention of urine results. If this retention is unrelieved, the bladder becomes overstretched, and the case progresses like an acute prostatic retention.

Retention may be the only prominent symptom. The gleet may not have been noticed, the gradual decrease in the size of the stream may have been ignored, when, after exposure, excess, or a carouse of liquor, retention suddenly comes on. Such was the onset in thirty-one of my cases.

Hematuria.—Exceptionally hematuria may be the most prominent symptom of stricture, indeed the only one noticed by the patient, which happened three times in my series. The bleeding comes from an ulcerated spot and may be quite profuse. The blood usually continues to drip after the close of micturition, a urethrorrhagia.

The bleeding comes from an ulceration on the surface of the urethra. It is therefore not a symptom of stricture that follows hard on the acute gonorrhea but of that which remains symptomless and therefore untreated for a number of years. Such strictures are rather superficial, usually do not consist of dense scar tissue, and are situated in the bulbomembranous region. It is thus curious that hematuria, the most alarming symptom of stricture, is suggestive of a relatively slight and unimportant lesion. Indeed, hematuria may be the outstanding feature of stricture due to non-gonorrheal urethritis.

Pain.—Pain on urination is due to prostatitis, cystitis, or retention. The pain is felt at the neck of the bladder, in the perineum, at the point of stricture, or near the glans penis.

Sexual Symptoms.—Excepting the impotence which results from grave stricture, all the other sexual symptoms that have been traditionally accredited thereto are actually referable to prostatitis, vesiculitis, or verumontanitis.

RESULTS OF STRICTURE

Hemorrhoids and Hernia.—The constant straining in urination keeps the hemorrhoidal vessels congested. This not infrequently results in hemorrhoids or rectal prolapse; occasionally, hernia occurs from the same cause.

Inflammation and Dilatation above the Stricture.—Prostatitis is an almost universal accompaniment of stricture. Vesiculitis is common; epididymitis far from rare.

Inflammation and dilatation of the upper urinary tract, the bladder, the ureters and the kidneys is as common a result of stricture of the urethra as of prostatism. But stricture occurs at an earlier age than prostatism; the bladder muscle is stronger at forty than at sixty. Hence the effect of stricture retention upon the bladder is usually to thicken the wall of that viscus and to contract rather than to dilate its cavity. The thickened wall, however, is no true muscular hypertrophy but is due rather to an infiltration with scar of a muscle that has not been overstretched.

As the bladder holds out better than in prostatism, so do the kidneys. Pro-

tected by the bladder they dilate more slowly than they would from prostatic retention.

Unless the prostatic sclerosis is sufficiently severe to cause sclerosis of the bladder neck, stricture does not cause that condition so characteristic of prostatism, partial retention of urine. Retention due to urethral stricture without prostatic sclerosis is either negligible or complete. Hence bladder stone is rarely the result of stricture.

False Passage.—False passage results from the rough or unskillful use of small instruments in an obstructed urethra (Fig. 59).

FIG. 59.—FALSE PASSAGE. (Dittel)

The surgeon making a false passage may be unconscious of the escape of the point of his instrument from the canal, but he soon perceives that it is behaving unusually. It is obstructed, but yet not held as though in the grasp of a stricture. The point, moreover, seems often to be turned out of the median line, and, after the instrument has been introduced far enough to reach the bladder, a rotary motion, imparted to the shaft, will show that the point is fixed in the connective tissue, and not freely movable, as it would be in the cavity of the bladder. In such a case a finger in the rectum will feel the point of the instrument just outside the wall of the gut, at the apex of the prostate, or perhaps lying between the prostate and the gut. On withdrawing the instrument, blood flows freely from the meatus.

Periurethritis.—Inflammatory stricture is actually a scar laid down about chronically inflamed glands or lacunæ; chronically inflamed because their orifices

are obstructed by scar, their cavities not provided with good drainage. In such a tissue inflammation readily occurs either through neglect of dilatation or through the trauma of overdilatation. Suppuration may equally begin in any of the urethral glands, notably the prostate, upstream from the stricture.

The fasciæ of the urethra and perineum determine the course of such suppuration. Prostatic abscess, if it bursts backward, and not forward into the urethra, either reaches the ischiorectal fossa and appears at the surface in front of or alongside of the anus, or is confined by the fascia of Denonvillier and extends downward into the perineum outside of Buck's fascia which surrounds the bulbocavernosus, and within the deep fascia of the perineum, or Colles' fascia. The suppuration of prostatic abscess, notably of the slower growing ones, especially if due to tuberculosis, therefore often reaches the surface in the perineum or may extend forward to the scrotum and up into the groin between the penis and the spermatic cord. Thence it spreads under the mons veneris and upward and outward toward the loin, beneath the deep layer of the superficial fascia (Figs. 60-63).

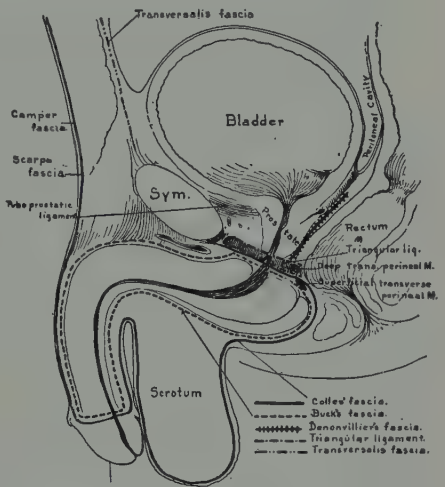

FIG. 60.—DIAGRAM OF FASCIA OF UROGENITAL REGION CONCERNED IN PERIURETHRAL ABSCESS.

Abscess from Cowper's gland is retained within Buck's fascia until it reaches the penoscrotal angle. Prostatic abscess, when it reaches the perineum, and abscess due to stricture are retained within Colles' fascia, fill the perineum and scrotum and extend thence to the groins. Periurethral gangrene is also confined by Colles' fascia. (Wesson)

Suppuration in Cowper's gland, which lies beside the membranous urethra, if hyperacute may take a similar course but usually it extends forward within Buck's fascia and passes along the urethra to about the penoscrotal angle. Here it is likely to form adhesion with the skin and burst through the anterior surface of the scrotum.

Suppuration from the bulbous urethra usually mats together the tissues immediately surrounding the urethra and breaks directly into the perineum, whence it extends to the scrotum, groin, or abdominal wall.

Suppuration from the penile urethra bursts directly through the skin of the penis.

Gangrene of the periurethral fascia, rarely of the corpus cavernosum, bursts from the bulbous urethra into the perineum and spreads rapidly to the scrotum, groin, or abdomen. This gangrene is usually spoken of as infiltration of urine for when the swollen scrotum and perineum are incised the watery fluid with which the tissues are filled seems urinous. This it is not, as comparison of its urea content with that of the urine obtained from the bladder will prove. I

have seen many a gangrene of the perineum but never a true infiltration of urine.

Indeed periurethritis and gangrene may arise from a stricture that is not particularly tight. Gangrene is not due to the entrance of urine into the tissues. It is an anaërobic infection from the urethra.

FIG. 61.—PERIURETHRAL GANGRENE.
The extension from perineum and scrotum to groin is outlined.

DIAGNOSIS

A history of prolonged mild intermittent gleet is peculiarly suggestive of stricture. Spontaneous urethrorrhagia is suggestive of stricture. Retention of urine is often due to stricture.

The Urine.—Large shreds in the urine are an indication of localized hard infiltrations in the anterior urethra, actual or potential strictures. These shreds may be obscured by free pus; but unless the stricture is controlled by treatment the urine always contains shreds.

Examination.—*Stricture of the pendulous or scrotal urethra* is disclosed by the bulbous bougie, which either fails to pass the strictured point or passes with a jump and is caught again by the stricture on withdrawal. If the bulb is 26 F. or smaller this establishes the diagnosis. But there are strictures of larger caliber. Before asserting that the patient has no stricture external to the bulb,

one must pass a 29 F. bulbous bougie, cutting the meatus if necessary in order to do so. Infiltrations of chronic urethritis, as yet unorganized, will obstruct the larger bougies quite as does the organized scar of a stricture. The distinction is perhaps of no great importance for the infiltration, if neglected, becomes a scar, a stricture. The infiltrate, however, yields to dilatation. The scar must be cut.

Stricture at the bulb is diagnosed by the sound. The bulbous bougie often pockets in the bulb of a normal urethra and will go no further, or as it enters the posterior urethra it is arrested by the muscle in a way to suggest the

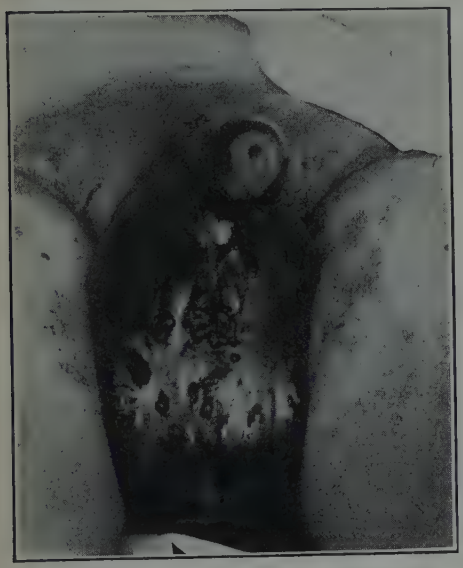

FIG. 62.—SAME PATIENT AS IN FIG. 60.

The discoloration of the swollen hypogastrium is seen above the tense scrotum. Observe also the hernia scar. The hernia had relapsed. Hence the inexpert operator feared to open the left groin widely. Hence the patient died septic.

FIG. 63.—PERIURETHRAL GANGRENE (IMPROPERLY TERMED URINARY EXTRAVASATION).

Note discoloration of thighs and abdomen. This scrotum should be amputated and wide liberating incisions made on abdomen and thighs.

presence of stricture. Hence the sound is preferable. It distinguishes scar, as a stricture, from infiltrate or spasm by the fact that when it has entered the stricture *it is grasped on withdrawal.* If a sound is not grasped we may say there is no scar, though there may be cellular infiltration. Blood follows withdrawal of the sound.

Impassable stricture is readily diagnosed except at the entrance of the posterior urethra. At any other point in the urethra the complete blocking of the canal must be either a foreign body or an impassable stricture. But at the entrance of the membranous urethra, a spasmodic muscle may completely obstruct the passage of instruments.

Spasmodic stricture is only a symptom, not a disease. It is actually a subjective spasm excited in some entirely normal persons by the immediate discomfort and fear resulting from the passage of an instrument into the urethra. In other instances the muscle is unduly irritable because of urethritis or prostatitis or other inflammation in the neighborhood. Again urethral spasm is seen as a postoperative complication, notably after pelvic operations when the patient is afraid to push against the sphincter hard enough to overcome its resistance. Hence the necessity for postoperative catheterization of these patients.

In diagnosing this condition, two things ought to be remembered; the spasm of obstruction is always at the junction of the bulbous and membranous urethra and the obstruction is always complete, the stricture impassable. Until some instrument can be passed through this obstructing muscle, it is impossible to be sure whether the obstruction is simply muscular or stricture or the two combined. If it is suspected that the obstruction is muscular, a full size sound will be gently introduced into the urethra after anesthetization and allowed to rest against the face of the obstruction where the patient is encouraged to relax his muscles in every way possible. If the obstruction is muscular, this will almost always succeed. Indeed it is years since, in my private practice, I have been bothered as to the diagnosis of spasmodic stricture; but the inexperienced hospital intern is frequently misled and occasionally the diagnosis is only made after the patient has been anesthetized for operation of his impassable stricture, when the sound, introduced for the purpose of locating the exact position of the stricture, discloses that there is none by slipping into the bladder. If, after an instrument has passed through the membranous urethra, there is still doubt as to the diagnosis, this is clarified on withdrawal. The spasm will grasp a soft-rubber catheter but not a sound, while an organic stricture grasps any instrument that has been passed through.

To tabulate these features briefly:

	Organic Stricture	Spasm	Urethritis
Shreds or pus....	Always present	Not present unless there is an inflammation	Present
Obstruction	Always present	Only in membranous urethra	Sometimes
Grasping	Always present	No	No

CHAPTER XXII

STRICTURE OF THE URETHRA: PROGNOSIS AND TREATMENT

PROGNOSIS

The prognosis of stricture depends upon the treatment more than upon any other one thing, but varies according to the nature and location of the scar. Traumatic strictures contract rapidly, in spite of treatment. Gonorrheal strictures, on the other hand, contract far less energetically. Strictures of the perineal urethra are far more difficult to cure than strictures of the pendulous urethra. The latter contract slowly and are commonly curable by urethrotomy; the former contract more rapidly and are incurable—that is, they may be relieved by sounding or urethrotomy, but they almost inevitably relapse after a time. Finally, the more extensive a stricture, the more irregular its surface, and the denser the cicatricial tissue composing it, the more difficult will be its treatment and the more dubious its cure.

In the matter of life or death, however, the prognosis of stricture is far less gloomy. Stricture is very rarely fatal, except in neglected cases. Death occurs in various ways.

1. Periurethral phlegmon, which, if extensive, kills at once by sepsis, or, later, by exhaustion, suppuration, abscess, gangrene, or pyemia.

2. Urinary septicemia, the retention resulting in pyelonephritis or pyonephrosis. The patient may die from such a cause even after the stricture has been dilated, or, as is more commonly the case, the treatment itself, whether by sound or knife, may induce urinary septicemia which closes the scene. The past generation of surgeons acknowledged a great mortality following urethrotomy. Our use of caudal anesthesia has almost completely annihilated this.

3. Sudden death following the passage of a sound. Such deaths are extremely rare, and are apparently due either to the use of cocain, to *status lymphaticus,* or to shock upon an impaired heart. This must be very rare. I have never seen it.

TREATMENT

Enlarge the urethra by dilatation, aided, if necessary, by cutting. Then maintain its caliber by dilatation. Or perhaps the negative view is more forcible. *Never cut if you can dilate; and recognize that the patient is not cured unless he stays cured.* Cutting is at best a substitute for dilatation, while divulsion and electricity are no substitutes.

Prophylaxis

Since most strictures are caused by gonorrhea, and the occurrence of gonorrheal stricture is favored by the intensity and the duration of the inflammation, every effort made to control this inflammation is so much toward the prevention of a possible stricture. Yet this is but an indirect prophylaxis, since it is impossible to prophesy which case of gonorrhea will terminate in stricture and which will not. But when the disease becomes chronic *in the anterior urethra,* although there be no stricture present, the inflammation is encouraged by and is in turn encouraging a periurethral sclerosis which develops into a veritable stricture. Therefore intelligent treatment of anterior urethritis is the surest preventive of stricture.

For traumatic stricture the proper prophylaxis is immediate operation at the time of injury.

Curative Treatment

Since the sound is the instrument best adapted to the cure of stricture, and since, unfortunately, it is easier to use a sound wrongly than rightly, a few words on the use and effects of sounds are required.

The surgeon attacking a stricture of the urethra may fairly analyze the therapeutic problem thus: "Here is a scar with a congested surface; shall I cut or shall I massage it?" If he cuts through it the symptoms are relieved, the obstruction is apparently removed, but the scar is still there. In fact, there is rather more scar than ever, and if the former scar contracted and gave trouble, so much the more will this one. To prevent this he will keep the lips of the wound separated by sounds, so that it may heal with so broad an insertion band that the contraction will be of no moment. Such a course will succeed in the pendulous urethra; but if the stricture is in the perineal urethra and of such density as to give the shadow of an excuse for cutting, it will certainly relapse after the operation unless subjected to systematic massage by sounds. The knife only relieves the congestion plus a temporary relief of the contraction, while the sound actually causes the resorption of the exudate. The effect of sounding is quite comparable to the effect of massage applied to the outside of the body. Moreover, *the maximum of effect is produced by the minimum of effort,* or, as Guyon puts it, "the effect is due, not to the pressure of the sound, but to its mere contact."

It is a matter of everyday experience that the brutal passage of a sound, bruising and tearing the congested urethra, is followed by a sharp inflammatory reaction, which increases rather than diminishes the exudate. Such treatment is inexcusable. The stricture is already congested, the mucous membrane already inflamed. What more futile procedure than to add irritation to irritation! Such is not the object of the sound. On the contrary, the sound, if a metal one, should slip in almost by its own weight; slowly indeed, but surely. Such

a maneuver has the treble effect of lessening congestion at the point of contact, straightening out irregularities in the canal, and stimulating the deeper tissues to a favorable reaction, which will result in softening the cicatrix. But to do this the sound must press without bruising. If a given sound will not pass, try a smaller one. The effect is readily judged. If a sound is properly introduced, it may usually be followed by sounds of the next larger sizes with less pain than the first. Larger sounds may be introduced at each sitting; the rapid amelioration of the symptoms shows that the congestion is relieved, the obstruction is disappearing, and the canal is resuming its normal condition. Yet, however gently a sound is introduced, it will be followed within forty-eight hours by a congestive reaction of more or less intensity. Hence, in treating stricture by dilatation it is bad practice to introduce instruments—unless filiforms—before the lapse of four days, and even longer intervals will often produce better results.

Lastly, and above all, gently, *gently,* GENTLY!

Treatment of Various Kinds of Stricture

The treatment of congenital strictures is operative. See pages 403 and 529. Apart from this, the treatment of stricture may be considered under the following captions:

1. Stricture of large caliber
2. Stricture of small caliber
3. Stricture admitting only a filiform
4. Stricture complicated by retention
5. Impassable stricture
6. Traumatic and resilient stricture
7. Stricture complicated by prostatitis (irritable stricture)
8. Stricture complicated by false passage
9. Stricture complicated by periurethritis or prostatic abscess
10. Stricture complicated by fistula
11. Stricture complicated by acute pyelonephritis

1. **Treatment of Stricture of Large Caliber.**—After the diagnosis has been made by the passage of a bulbous bougie, no further instrumentation is advisable until the effect of exploration has been observed. The chances of urethral chill after the first examinations must be remembered. The patient must be instructed in urethral hygiene, the nature of his malady must be explained, and, to forestall future disappointment, he should be informed at the outset that, after his symptoms have been relieved by treatment, the permanence of his cure, *if his stricture is deep in the urethra,* depends upon years of further sounding at proper intervals, in order to prevent recontraction.

Being instructed not to mind the smarting at his next urination, a few c.c.

of acriflavin, 1 : 1,000, are injected and the patient is instructed to return in four days for dilatation.

Sounds.—The treatment best adapted to the majority of these cases is dilatation with a conical double taper steel sound. One of these instruments properly sterilized is introduced in the manner already detailed. Its size should correspond to that of the bougie that has passed the stricture, and the utmost delicacy, care, and gentleness should be used in its introduction. As soon as the instrument has entered the bladder it should be withdrawn at once. Nothing is gained by leaving it even for a moment. During withdrawal the stricture is usually felt to grasp the sound. After one sound has been withdrawn, a second and even a third may be introduced. It may be stated as a rule, subject to judicious exception, *that if a conical steel instrument of any size larger than 20 F., when held in proper position, will not enter a stricture almost by its own weight after a little delay, it should not be used.* Every urethra, however, has its own temper; some are aroused by the slightest disturbance, while others bear considerable violence without protest. A surgeon should acquaint himself by gradual experiment with the temper of a given urethra before he takes liberties with it.

The mischief to be feared from the employment of large sounds with force, besides false passage, which is not likely to be produced by large instruments, is threefold:

1. Acute prostatitis or epididymitis, a common result of violence to the urethra, and a complication which suspends treatment and confines the patient to bed for several weeks.

2. Inflammation in the stricture, which aggravates its condition and threatens periurethritis.

3. Chill and urethral fever.

The third danger, the chill and fever, is very unusual after manipulation of the pendulous urethra—witness the impunity with which one may cut far and wide through that part of the canal—and increases as we approach the bulbomembranous junction. Some persons have a predisposition in this regard, and the presence of some renal lesion is essential as a predisposing cause of any real septic chill. Yet in no given case can the prognosis be definite, and the only safety lies in hedging the operation about with all possible precautions.

The rule which I have found most efficacious is: (1) Hexamethylenamin before, (2) gentleness during, (3) injection of acriflavin, 1:1,000, after sounding.

At each subsequent visit of the patient, the surgeon commences with a sound from one to two sizes smaller than the last instrument introduced at the previous visit, and carries the dilatation as far as possible without the employment of force, till the full size is reached.

The Interval.—The most important feature in the treatment of stricture by dilatation is a proper regulation of the intervals to be allowed between the visits. The intervals usually recommended are too short. We can only repeat

that *it is bad practice, in treating stricture by dilatation, to reintroduce instruments—unless filiform—before the lapse of at least four days, and even longer intervals will often produce better results.* I usually pass sounds once a week.

In the majority of cases the physiological gauge—the normal meatus—is adequate. A stricture once dilated to this size—which will vary from 28 to 32 F.—will stand the test of a cure—that is, the inflammation about it, and not necessarily the prostatitis, will rapidly disappear, and the stricture will not recontract during the lengthened intervals of sounding that constitute the after treatment. But occasionally the meatus is too small a gauge. The outer fibers of the scar lie so deep and are so elastic that they are unaffected by the pressure and tend to recontract as soon as the lengthened intervals of sounding permit them to do so. Such strictures must be cut or stretched with the Kollmann dilator until a point is reached where they do not recontract.[1]

Meatotomy vs. the Kollmann Dilator.—If the meatus is too small to permit efficient sounding, it should be cut. Urethral infiltrates and strictures yield far more kindly to the sound than to the Kollmann dilator and even a slight meatal constriction encourages chronic anterior urethritis.

Urethrotomy.—Cutting may be resorted to:

(*a*) If the stricture will not dilate.
(*b*) If the patient has not the time to go through a long course of dilatation.
(*c*) If the urethral fever follows all attempts at dilatation.

Choice of Urethrotomy.—External section is best suited to grave strictures of the bulb, internal section to strictures of the pendulous urethra. There still remains a choice of instruments for internal urethrotomy, which choice is simply a matter of taste. I like the bistoury for strictures near the meatus. Otis's dilating urethrotome for any stricture of the pendulous urethra large enough to admit that instrument, and Maisonneuve's urethrotome for those strictures through which an Otis instrument will not pass.

After Treatment.—The after treatment depends upon the location of the stricture.

If the stricture is in the pendulous urethra, the surgeon may feel confident that a cure persisting three months will prove permanent. When the stricture has been dilated fully, so that there are no longer any large shreds in the urine,

[1] Otis's Theory.—Such was the basis of Otis's famous theory. Meeting many strictures incurable by the half-hearted methods of dilatation then in vogue, and finding that a generous incision cured stricture of the anterior urethra, he evolved the theory that the urethra is an evenly calibrated tube whose size bears a direct relation to that of the flaccid penis. This ratio he fixed at 10 mm. of urethral circumference to every inch of penile circumference. Thus, a 3-inch penis should take a 30 F.; a 3½-inch penis a 34 F. The objection to Otis's theory is that it is incorrect. The urethra is no more an evenly calibrated tube than the ureter, the esophagus, or the bowel. Its size no more varies with that of the penis than does the size of the esophagus with that of the neck. The objection to Otis's practice is that it involves an unnecessary and harmful amount of cutting, since, as a rule, the patient can get well without it, and the operation may leave a canal defective in expulsive power. Moreover, though this wide cutting cures strictures of the pendulous urethra, it does not cure deep strictures.

the patient may be dismissed to report in two weeks. If at that time there is no recontraction, he may be dismissed for a month, and again for two months, when his cure may be pronounced permanent. If, however, there is a relapse on any of these occasions, visits must be renewed, and the patient's cure insured by higher dilatation or a further cutting.

Stricture in the bulb is a different matter. In all such strictures, except those soft bands that yield to one or two passages of a sound, recontraction will almost inevitably take place, unless the cure be maintained by the passage of a full-sized sound. This is easily done by the patient. In a few lessons he acquires the art of gently passing a sound upon himself, and he should be seriously cautioned to perform this trifling but important operation once or twice a year. If the sound fails to pass on some such occasion he must report for examination. In this way, in some cases, the use of instruments may be gradually abandoned; in the majority, it will have to be continued indefinitely, at intervals varying from a month to a year. Thus the cure becomes radical. The surgeon is responsible for the cure only on condition that the patient carries out this plan; or, rather, the patient is responsible for the permanence of his own cure, and this he must be made distinctly to understand.

2. **Stricture of Small Caliber.**—To this class belong strictures admitting any instrument less than 20 F. They are considered separately because they are better treated with soft than with steel instruments. The danger of making a false passage in an obstructed urethra with a small metallic instrument cannot be overrated. No one can appreciate the ease with which a false passage is made until he has himself made one. Indeed, a surgeon, not well acquainted with the urethra, may make a false passage, and go on dilating it instead of the stricture, wondering meantime that the size of the stream is not increased or the symptoms alleviated. Only a surgeon who knows every line of the urethra may occasionally assume the risk of using a small metallic instrument in the canal without a guide.

Dilatation is carried on as already directed, steel instruments being used as soon as the stricture will admit No. 20.

3. **Stricture Admitting Only a Filiform, but Not Complicated by Retention.**—The very failure of larger instruments to pass, which tells us that filiforms must be employed, so distorts the orifice of the stricture as to make the passage of filiforms most difficult. Consequently only one or two brief efforts should be made at this time. If these fail further efforts should be deferred for forty-eight hours.

As a preliminary the urethra should be injected with 10 per cent novocain. This is preferable to oil or adrenalin.

Introduction of Filiforms.—Filiforms are apt to catch in the urethral folds and crypts both in front of and behind the stricture.

The following maneuvers are employed to overcome this difficulty:

1. When an instrument catches, partially withdraw and slightly rotate it, pushing it forward while making the rotatory movement. This device rarely

fails in finally engaging the instrument in the orifice of the stricture, especially if the filiform point be bent or twisted so that its extremity may lie outside of the axis of the shaft of the instrument.

2. An excellent method of finding the orifice of a stricture consists in cramming the urethra full of filiform bougies, engaging their points in all the lacunæ and false passages, and then trying them, one after another, until that one is pushed forward which is presenting at the orifice of the stricture, when it will at once engage.

3. If the point of the filiform passes the stricture but catches in the prostatic urethra, it may be lifted into the bladder by a finger introduced into the rectum.

4. Where filiforms fail a 10 F. urethral sound may pass by virtue of its curve. Only the expert surgeon may employ such an instrument with impunity.

5. If the stricture is a single band the face of which may be reached by the urethroscope, this instrument is introduced, the stricture wiped with adrenalin until it ceases to bleed, and a filiform then introduced, guided by direct ocular observation. This maneuver rarely succeeds where other means fail.

After Treatment.—After a filiform has been introduced the stricture is dilated to 10 or 12 F. When the patient is next seen, two days later, a 10 F. bougie will usually pass, or we may have to resort to filiforms again.

If drainage of the upper urinary tract is deemed necessary, a filiform may be tied in.

4. Retention.—Acute retention requires immediate relief. The patient should be placed in a hot bath, more hot water being added after he has become accustomed to the first heat, and this carried as high as bearable. He should remain in the bath from fifteen to twenty minutes, and should attempt to empty his bladder while in the water. If the heat is sufficient to induce nausea or faintness, it is more likely to produce the desired effect of relaxing the stricture. Following this relief an attempt at dilatation should be made as described in the preceding section.

If these expedients fail, the bladder may be aspirated once. Then the patient is put into a hot bath for twenty minutes and a final attempt made to introduce a filiform. This failing, the stricture may be fairly considered impassable.

In drawing the urine from a distended bladder, decompression, as for prostatic retention, may be required. Too quick emptying of the chronically distended bladder has been followed by hemorrhage, collapse, and even sudden death.

5. Impassable Stricture.—No stricture, congenital atresia excepted, is impervious unless the urethra has been cut across and all the urine escapes behind the cut, or unless the urine escapes through fistulæ. If a drop of urine can pass, the stricture is pervious. Our inability to pass instruments is due to the crookedness, not to the tightness, of the stricture.

How far the surgeon shall continue coaxing the urethra before resorting to external urethrotomy without a guide is a matter to be decided on the

merits of each individual case. If the patient is difficult to manage, and there is fear that, once relieved from his present necessity, he may not submit to treatment, it is a kindness to take advantage of his misfortune by insisting upon perineal section at once.

But external perineal urethrotomy without a guide is a difficult operation, and is not to be undertaken lightly. If it is the patient's first retention, if he was previously passing a fair-sized stream, and if the bladder is not already too full, it is always well to try palliative measures. But, on the other hand, it is not wise to fritter away time to the permanent detriment of the patient's bladder and kidneys when a stroke of the knife would solve the difficulty.

6. Traumatic and Other Resilient Strictures.—Traumatic strictures close down with great rapidity and are very rebellious to treatment. They are resilient. When dilated ever so little they recontract and often are made worse, rather than better, by sounds. Under such conditions dilatation is a losing game. The knife must be used. When the scar is linear, simple perineal section will suffice to render it amenable to the sound. When, as is often the case, the scar is annular and fibrous, all the scar tissue, both on roof and floor, must be cut away. The urethral wound may need to be closed by suture or graft, but that does not signify: the scar must be removed at all costs, since it never loses its retractile quality, and simple section will be followed by a recontraction almost as rapid as after the original injury. Cabot's resection is the ideal operation for such cases. The most desperate cases can be controlled by the Pasteau resection. Preliminary suprapubic derivation of the urine is an essential part of any operation.

The ultimate results of resection of stricture will be satisfactory if there is no tuberculosis and if the patient will permit repeated operations at intervals of six months to a year, if the surgeon is careful always to turn aside the urinary stream, to leave a wide-open urethra and, in his final reconstructing operation, to build up a thick perineum below the urethra.

Other resilient strictures must be dealt with similarly.

7. Stricture Complicated by Prostatitis (Irritable Stricture).—Strictures classed as irritable in reality present no peculiar irritability in themselves, but they are complicated by prostatitis. As soon as the point of the sound or the bougie passes well through the stricture it glides over the prostatic urethra, the really irritable point—though, be it understood, only the minority of strictures complicated by prostatitis are irritable—and provokes an exacerbation of the prostatic inflammation or a sharp chill. When such a complication presents itself the simplest solution is perineal section; but this is not always essential. By bracing the patient's general health, by employing rather large doses of hexamethylenamin, by using the utmost gentleness in sounding, by preferring bougies, which are less violent to the prostatic urethra than sounds, or else blunt sounds whose points need not enter the prostate at all, and by treating the stricture only sufficiently to permit local treatment of the prostatitis until the latter is materially improved—by such means operation may often be avoided.

8. Stricture Complicated by False Passage.—The treatment for a fresh false passage is to let it absolutely alone for a week, if the patient can urinate, and is in no pressing need of relief. Blood will flow for a day or two, then pus for a few days, and at the end of a week, in favorable cases, the passage opened by the instrument will often have closed.

In avoiding an old false passage, the seat of chronic suppuration, its position must be accurately studied by observing at what point in the urethra an instrument engages in it and from which the wall of the canal, the upper or the lower,[2] it starts.

The orifice of a false passage once accurately located, may be subsequently avoided by making an effort to present the beak of the instrument at a different portion of the canal when passing the dangerous point.

If repeated attempts fail, or if suppuration and periurethritis intervene, perineal section should be performed without delay.

9. Stricture Complicated by Periurethritis.—There is no sane palliative treatment of periurethritis and its complications. The *simple inflammatory areas* should be treated by gentle soundings, aided by hot sitz-baths. Under such a course they suppurate or disappear.

Periurethral or Prostatic Abscess requires prompt evacuation and drainage.

Periurethral Gangrene demands immediate and radical incision. The patient's life is entirely in the surgeon's hands. Timorous incision is the patient's death-warrant. The infiltrated area must be slit open from end to end. Necrotic tissue must be sacrificed with no thought of ultimate disfiguration (Figs. 60-63).

10. Stricture Complicated by Fistula.—The chief aim in the treatment of fistula is to remove the impediment to urination—to *dilate the stricture.* This done, the fistula may close. If it fails to heal promptly, perineal urethrotomy should be performed, and the fistula excised.

11. Stricture Complicated by Acute Pyelonephritis.—The kidney must be drained either by a retained catheter or by perineal section. The tube should remain in place until the temperature touches normal. This failing, nephrotomy or nephrectomy is required.

Summary of Treatment of Stricture

1. Hexamethylenamin, sedatives, alkalies and rest are serviceable in some cases of stricture; indispensable if there be any serious complication.

2. All uncomplicated strictures, not highly irritable or resilient, should be treated by dilatation with soft instruments up to 20 F., and with conical steel sounds afterwards—reintroductions being made once a week.

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[2] Guyon states that he never met a false passage on the roof, hence advises following that wall of the urethra to avoid it. I have, however, met two cases of false passage on the roof, as shown by external urethrotomy, and have seen one other with the urethroscope.

3. Until well acquainted with the temper of a given stricture, every sounding should be preceded by hexamethylenamin, followed by acriflavin or other local antiseptic.

4. The meatus should be cut if it is the least bit tight.

5. Any stricture-resisting dilatation must be cut.

6. For the pendulous urethra, internal urethrotomy. For the perineal urethra, external urethrotomy or the combined operation.

7. In general, anterior stricture of the urethra is curable, deep stricture of the urethra, though more readily dilated, is very rarely cured.

8. Impassable stricture without retention may usually be overcome with filiform bougies by time, patience, and skill. If finally proved impassable, the treatment is external perineal urethrotomy.

9. Retention is treated by hot baths; these failing, by aspiration, or by external urethrotomy without a guide.

10. Traumatic stricture may be prevented by section at the time of injury. Once having shown itself, it usually requires resection.

11. Resilient strictures are best treated by resection.

12. Irritable strictures may often be cured without cutting.

13. Acute inflammatory complications usually call for operation.

14. Unless secondary retention has occurred in the ureter or renal pelvis, drainage of the bladder by division of the stricture will relieve an acutely infected kidney.

CHAPTER XXIII

THE PROSTATE: ANATOMY, PHYSIOLOGY; PROSTATISM

ANATOMY

The prostate is a sexual organ, partly glandular, partly muscular, lying in front of the bladder and surrounding the prostatic urethra (Fig. 64).

In *shape* the prostate is an irregular truncated cone. It has been aptly compared to a horse chestnut. Its apex rests against the posterior layer of the triangular ligament. Its base, toward the bladder, is pierced above by the urethra, below by the ejaculatory ducts. Its upper (anterior) and lateral surfaces are rounded, its lower (posterior) surface presents a boss on each side of the median line. It is to this lower surface particularly that the title heart-shaped or chestnut-shaped applies.

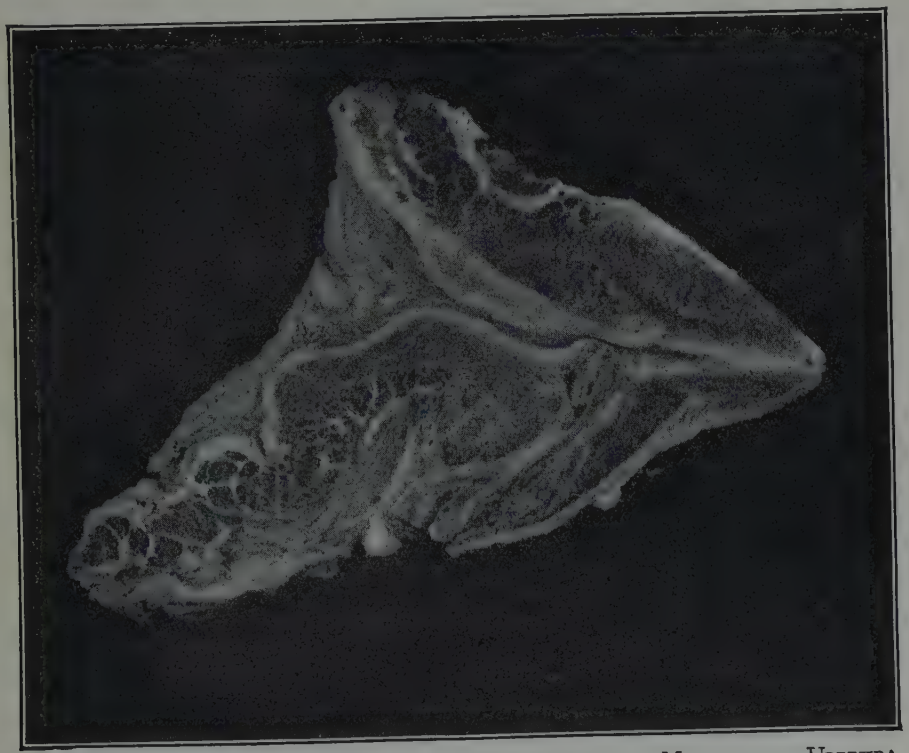

Fig. 64.—Sagittal Section of Prostate, Bladder Neck and Membranous Urethra. Division of gland by urethra and ejaculatory ducts well shown.

The *diameters* of the prostate, as given by von Frisch, are: length, 33 to 45 mm.; width at the base, 34 to 51 mm.; thickness, 13 to 24 mm.; by Thompson; length, 25 to 30 mm.; width at the base, 32 to 40 mm.; thickness, 20 to 25 mm. Its *weight* is 16 to 24 grams. In *position* it is 8 to 12 mm. below the symphysis, and its apex is 30 to 40 mm. from the anus. Its long axis makes an angle of 20 to 25 degrees with the perpendicular.

The prostate is supported by the puboprostatic ligaments and the levator prostatæ, the anterior fibers of the levator ani.

It is fixed in its relations to the urinary organs by the urethra, which pierces it from base to apex, as well as by the decussation of its muscular fibers with those of the bladder and the urethra. It is separated from the rectum by the fascia of Denonvillier, an offshoot from the pelvic fascia which passes down behind bladder, vesicles, and prostate, separating these from the rectum. Within this fascia and surrounding the prostate, especially in front, lies the prostatic plexus of veins.

Gross Anatomy.—The prostate may be considered as a gland divided into two parts by the ejaculatory ducts. These enter the gland close together at its base, and run through it obliquely, opening finally into the urethra at or near the sinus pocularis. That part of the gland behind the ducts is called *the posterior lobe*. This part of the gland may become carcinomatous. It never becomes hyperplastic.

The glandular tissue in front of the ejaculatory ducts is divided more or less arbitrarily into an anterior, a median and two lateral lobes. Lowsley has shown that in fetal life these lobes are usually quite distinct. But after birth the glands of the anterior lobe usually disappear and the separation between the other three, lying behind and to each side of the urethra, is quite arbitrary. The median lobe may be inseparable from one or both of its lateral fellows. The median lobe of the normal prostate makes no projection from its surface. The "middle" lobe of prostatism is quite a different matter.

The prostate has a thin fibrous capsule.

Microscopic Anatomy.—The *muscular tissue* is arranged in so irregular a manner that no two observers are agreed as to its exact distribution. Walker believes that the prostatic muscle is so arranged as to compress the gland as a whole, and each individual lobule of it in particular, but is not calculated to compress the urethra. This view is in accord with the fact that women—who possess no prostate—have complete control of the bladder without any additional muscle to take the place of this gland.

The *glands* are of the compound racemose type with cylindrical epithelium, which may be flattened by pressure or may appear in a double layer. They are collected into lobules, 15 to 32 in number, each lobule surrounded by a layer of muscle and emptying by a duct into the lateral portions of the floor of the prostatic urethra, some behind and some in front of the verumontanum. All these ducts point toward the orifices of the ejaculatory ducts, so that the prostatic secretion is mingled with the semen at the moment of ejaculation.

A small but important group of urethral glands lies upon the floor of the urethra within the grasp of the sphincter. Occasionally a few similar glands are found upon the trigone—the glands of Albarran.

The *arteries* are derived chiefly from the inferior vesical. The *veins* form the prostatic plexus. The *lymphatics* are very numerous. They pass to the internal iliac and obturator lymph-nodes. The *nerves* are derived from the inferior hypogastric plexus of the sympathetic.

The Prostatic Urethra.—The urethra extends from the bladder downward and forward through the prostate, so that, although the base of the gland lies below and behind it, the urethra emerges quite at the center of the apex of the prostate. The anatomy of the prostatic urethra has already been described (p. 26).

PHYSIOLOGY

The prostate is the sexual heart. It has nothing to do with urination, and is merely accessory to this act. But toward the sexual function it acts as a muscle, a sensory organ, and a gland.

As a *muscle* it acts to open the ejaculatory ducts, thus permitting the escape of the semen into the prostatic urethra, to express its own secretion into the prostatic urethra, and probably to expel it into the anterior urethra. An accepted function of the verumontanum—viz., to close the vesical orifice and prevent regurgitation of semen into the bladder—has been denied by Walker and others.

The seat of *sexual sensation* in the prostatic urethra is, perhaps, throughout its mucous membrane, but more probably it is confined to the verumontanum. When erection has been stimulated by friction of the glans penis the verumontanum becomes congested and irritated, perhaps by a spinal reflex, perhaps by the gradual influx of semen into the prostatic urethra, and ejaculation results.

The *glandular function* of the prostate is no less interesting. Besides acting as a simple diluent, it adds something to the semen that keeps the spermatozoa alive for several days, whereas other diluting fluids keep them alive only three or four hours.

The *secretion* of the prostate is a thin, turbid fluid of watery consistence, of slightly acid reaction, and of seminal odor. Its qualities in health and disease have already been described.

There is probably an *internal prostatic secretion* that stimulates spermatogenesis.

PROSTATISM

Prostatism, miscalled prostatic hypertrophy, is either a hormone hyperplasia or a sclerotic condition of the prostate, causing obstruction to the outflow of urine through the urethra.

Although every hyperplastic prostate shows areas of sclerosis and every

sclerotic prostate hyperplasia, it is convenient to distinguish the common or hyperplastic type of prostatism from the rare sclerotic type.

Etiology of Hyperplasia

Age.—Prostatism is a disease of later life. It rarely causes symptoms before the fiftieth year.[1] The patients begin to suffer, for the most part, between the ages of fifty and sixty-five.

Frequency.—According to Thompson's figures, 34 per cent of men reaching the age of sixty have enlarged prostates, and less than half of these suffer from prostatism. This estimate is substantially accurate.

The size of the hyperplasia bears no relation to the age of the patient, nor, as we shall see, to the symptoms.

Pathogenesis.—Velpeau and Thompson thought prostatic hyperplasia myomatous, but perfection of staining technic soon proved the enlargement to be glandular in character. Myomata of the prostate are rare and small, mere pathologic curiosities.

Guyon [2] believed the prostatic lesions to be local manifestations of gummal arteriosclerosis. But Casper [3] and Motz [4] proved that the association of the two conditions is purely fortuitous.

Ciechanowski [5] alleged that the lesions of chronic prostatitis, prostatic sclerosis and prostatic hyperplasia were essentially the same, all inflammatory in origin and usually due to gonorrhea. Harlow Brooks [6] accepted this theory and Wilson and McGrath [7] supported it. Although all enlarged prostates show inflammatory lesions and prostatic sclerosis is unquestionably a terminal cicatrization of the lesions of prostatitis, it is a matter of common knowledge that prolonged prostatitis, gonorrheal or non-gonorrheal, destroys by scar so large a proportion of the prostatic epithelium as to diminish the prospect that the subsequent gland hyperplasia will ever be sufficient to obstruct urination. The consolatory adage, "Stricture of the urethra is the best preventive of prostatism," is not quite true, for patients with stricture may later suffer the obstruction of sclerotic prostatitis; but I have been able to show statistically that all such chronic urethral infections diminish the incidence of prostatism.

J. W. White [8] was nearer the truth when he alleged sexual senility as the cause of prostatic hyperplasia. Like hyperplasia of the breast and myoma of the uterus in women, prostatic hyperplasia begins as youth departs and the

[1] Gardner and Simpson found the lesions of hyperplasia but once among fifteen prostates of men less than forty years of age; five times among nineteen prostates of men between forty and fifty, and seven times among twenty-one in the next decade.

[2] *Ann. d. Urol. d. org. Genito-Urin.*, 1885, iii, 148.

[3] *Virchow's Archiv.*, 1891, cxxv, 139.

[4] *Structure histologique de l'hypertrophic de la prostate*, Paris, 1896.

[5] *So-called Prostatic Hypertrophy*, trans. by R. A. Streeve, 1903.

[6] *J. Am. M. Ass.*, 1911, lvii, 1601.

[7] *J. Am. M. Ass.*, 1904, xliii, 187.

[8] *Ann. Surg.*, 1893, xviii, 152.

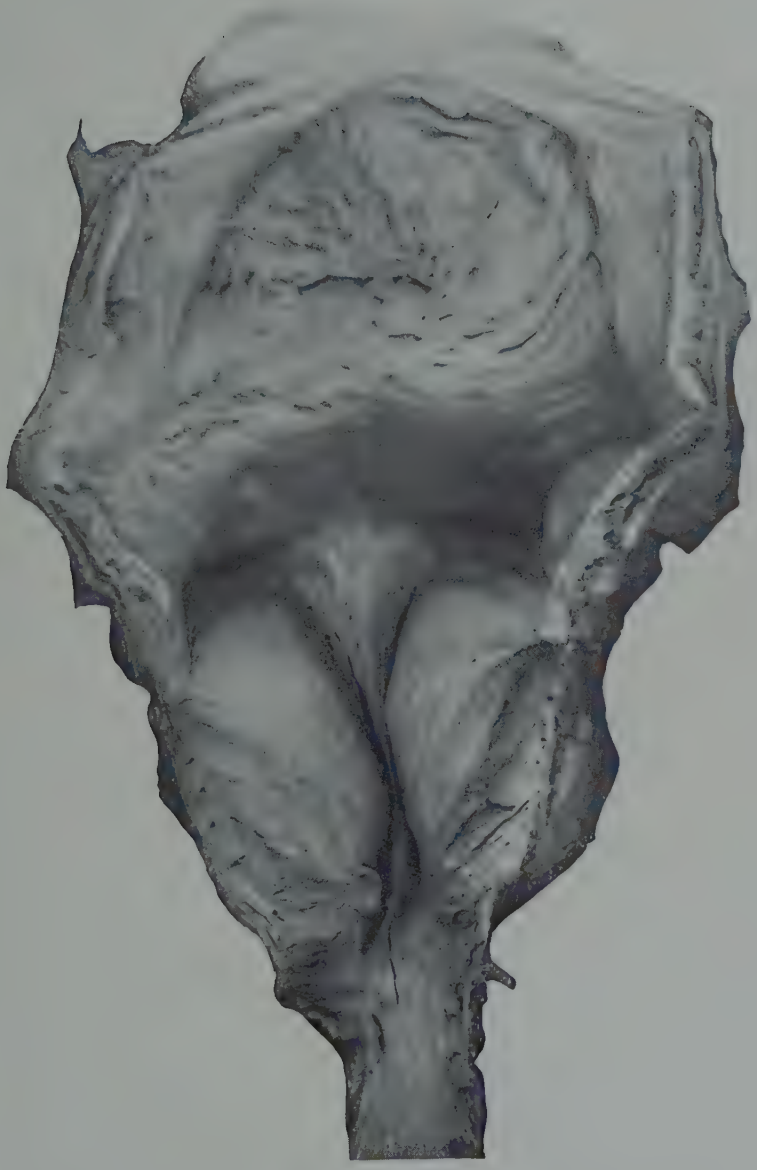

PLATE X.—THE USUAL TYPE OF PROSTATISM.

General prostatic enlargement, with middle lobe projection. Note position of verumontanum.

natural sexual urge diminishes. It is manifestly a by-product of the change in hormone activity that characterizes "middle life." Frazer applies to it the term "hormone hyperplasia."

This at least is sure. Hyperplasia is not a neoplasm. It is not an adenoma. Its association with carcinoma of the prostate is purely fortuitous.

But does prostatic congestion encourage the development of hyperplasia? It is not easy to say. Most prostatics are married men and among the clergy the celibates seem relatively immune from prostatism as compared to the married. But we recognize congestion as the immediate occasion of the swelling in the gland that induces acute retention of urine.

Etiology of Sclerosis

Sclerosis is the result of inflammation in the prostate. Yet the character of the inflammation that occasions prostatic sclerosis is not quite clear. Retention due to prostatic sclerosis occurs at all ages. It occurs in infancy, occasioning retention of urine, megalo-ureter, hydronephrosis, at this time of life when one would suppose the prostate quite immune from inflammation. For this I know no explanation.

It occurs in youth and in middle life, often with bladder diverticula, apparently quite independent of any recognized antecedent prostatitis or gonorrhea.

After gonorrhea the urethroscope or the cystoscope may discover a rigid bladder neck that tilts up the cystoscope, yet this rigidity does not often occasion retention of urine. Indeed, the mere fact that in old age retention due to prostatic hyperplasia is almost ten times as frequent as that due to sclerosis is bafflingly disproportionate to the frequency of gonorrhea in youth. Yet we see cases of prostatic retention due to sclerosis that seem definitely to date from chronic prostatitis.

Morbid Anatomy

Though prostatic sclerosis and hyperplasia are distinct entities, pathologically as well as etiologically, the lesions found in prostates of men who have reached the "prostatic" age are rarely pure hyperplasia and even less often pure sclerosis. One may distinguish three types, the usual type, in which the lesions of hyperplasia dominate, the purely sclerotic type in which no gross hyperplasia is discerned, and a mixed type in which antecedent sclerosis inhibits hyperplasia to a varying degree in different portions of the gland.

Hyperplasia.—The so-called hypertrophy of the prostate consists essentially in a distention of the acini with proliferation of the epithelium occurring in those portions of the gland nearest the urethra, resulting in the formation of masses of gland tissue which have been aptly described as pseudo-adenomata. They adhere only to the mucosa covering them and are readily shelled out from the compressed periphery of the gland. On section those pseudo-adenomata

(Fig. 66) are complex agglomerations of the hyperplastic gland tissue, riddled with small cysts, some of which contain corpora amylacea or perhaps prostatic calculi.

Under the microscope the hyperplastic tissue presents the appearance of a multilocular cystadenoma with sufficient heaping up of cells to suggest true tumor or even malignancy to the inexpert. Here and there true small adenomata or leiomyomata may be found. The interstitial tissue is here and there infiltrated with leukocytes or changed into scar.

Since Jores suggested that the glands lying along the posterior urethra and about the bladder neck are chiefly concerned in the hyperplasia, compressing the

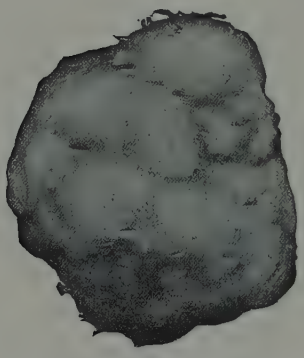

FIG. 65.—LOBE ENUCLEATED FROM A HYPERPLASTIC PROSTATE.

FIG. 66.—SECTION OF A LARGE PROSTATIC "LOBE," SHOWING ITS COMPOSITE CHARACTER.

prostate gland proper into a dense pseudocapsule, this discovery has been many times repeated, though it is not yet clear how large a part is taken in the hyperplastic process by the gland tissue of the prostate itself.

The posterior lobe, behind and below the ejaculatory ducts, is never involved in the hyperplasia. Unless interfered with by dense preëxisting sclerosis, the hyperplasia forms a symmetrical trilobed growth, two lateral lobes and a separately projecting "middle" lobe joining these two in the form of a bar, a projection or even a pedunculated tumor. These masses attain diameters of 2 to 5 cm. and lie between the verumontanum and the bladder neck, elevating the latter, tilting the trigone backward and hiding it and the ureter mouths from inspection by the cystoscope. They lengthen the posterior urethra, elongate its curve and greatly increase its caliber: it becomes a deep slit between the large lateral lobes (Fig. 67).

Exceptionally one lateral lobe develops the lesions of hyperplasia years before its fellow is affected. One of my patients had the misfortune, after the relief of his retention by my removal of one lateral lobe, to suffer a recurrence of symptoms ten years later as the opposite lobe enlarged. The rule is almost

absolute, however, that unless impeded by sclerosis the three lobes develop together.

Desnos's specimens ranged in weight from 23 to 85 grams. Much larger tumors are occasionally met with, but in the usual run of cases the prostate is smaller than a plum.

The notable gross changes associated with prostatism are (1) bulging of the posterior surface of the gland, (2) elevation of the urethral orifice, (3) production of a projecting middle lobe, and (4) lengthening and distortion of the prostatic urethra.

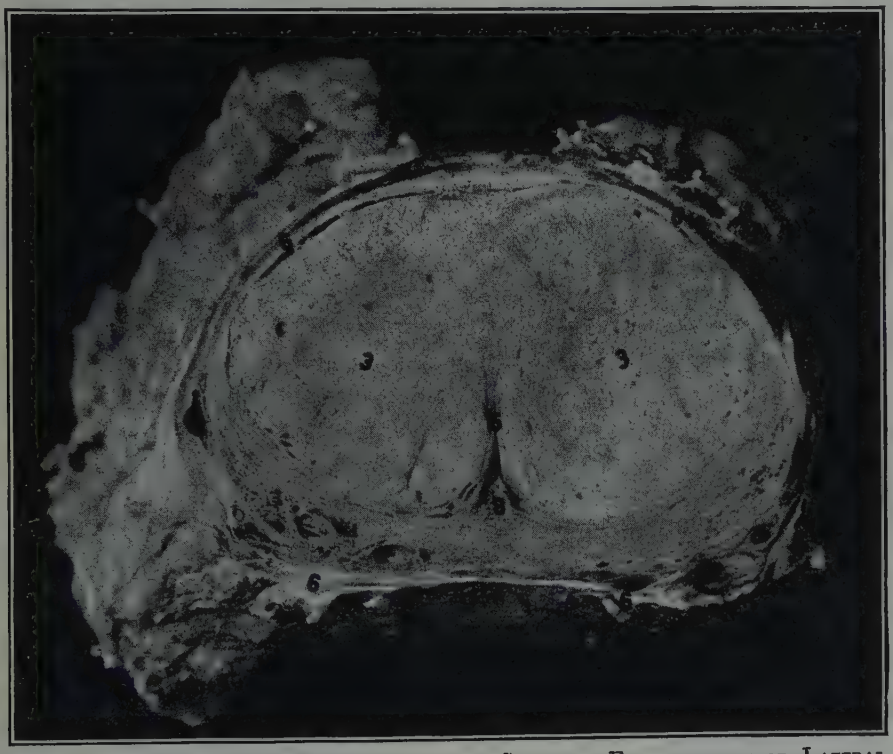

FIG. 67.—PROSTATISM: TRANSVERSE SECTION SHOWING ENLARGEMENT OF LATERAL LOBES.

3, lateral lobe; 5, urethra; 6, capsule; 8, verumontanum.

1. *Posterior Bulging.*—The lateral lobe enlargement may be felt by rectal touch. The examining finger, instead of impinging upon a scarcely perceptible organ, encounters a large mass, perhaps the size of a plum, perhaps so large that its upper border cannot be reached. To estimate the size of the growth the finger is swept over it from side to side, into the sulci between it and the lateral wall of the rectum, and, if possible, over the top of the tumor. Its increase in all three dimensions may thus be fairly estimated and its general elasticity determined. In shape the mass is usually quite globular, but a little furrowed down

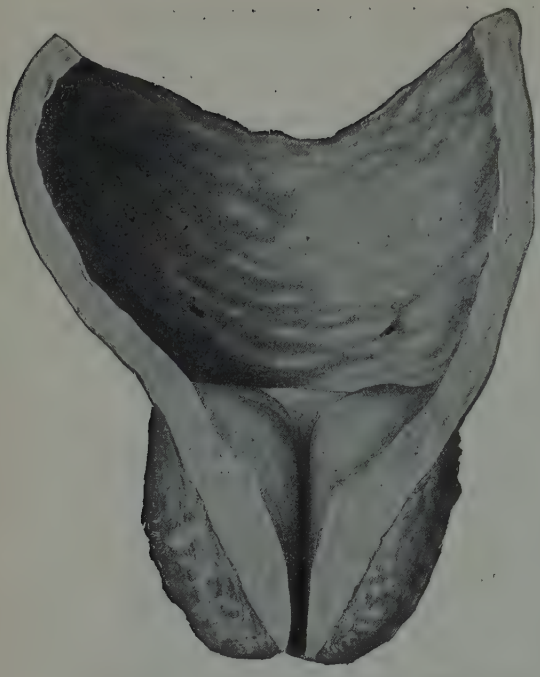

FIG. 68.—BILATERAL PROSTATIC ENLARGEMENT.

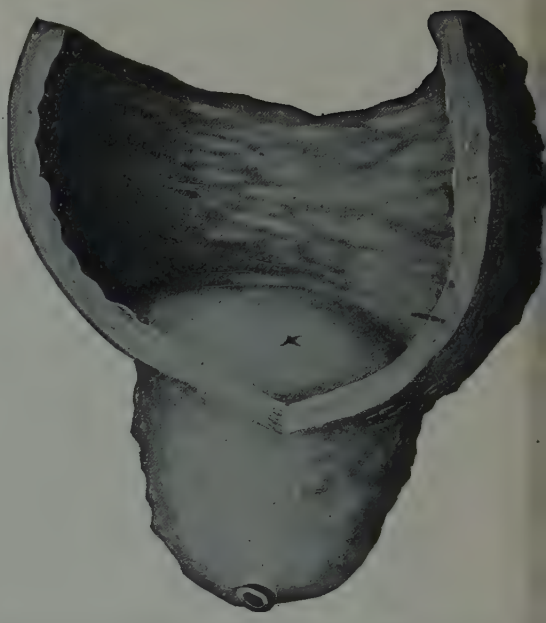

FIG. 69.—GENERAL SCLEROSIS OF THE PROSTATE. CONTRACTURE TYPE.

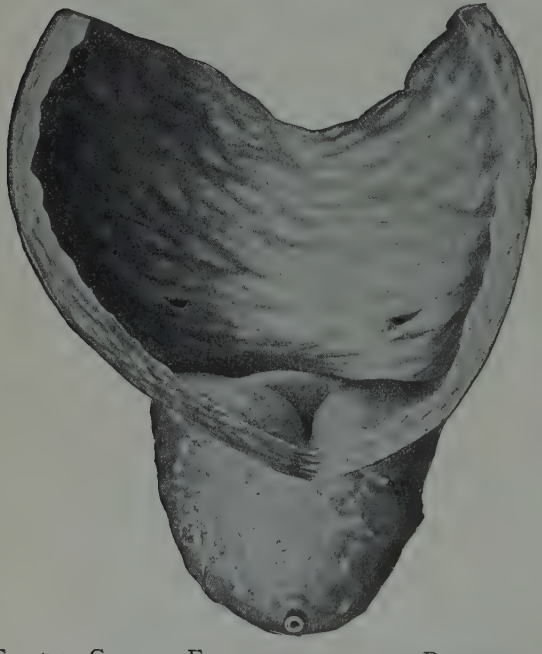

FIG. 70.—GENERAL ENLARGEMENT OF THE PROSTATE WITH MEDIAN BAR.

FIG. 71.—PEDUNCULATED MEDIAN ENLARGEMENT.

the center. One lobe may be more enlarged than the other. One notes the general dimensions of the growth, the obliteration of the median furrow, the mobility of the gland within the pelvis.

2. *Elevation of the Urethral Orifice.*—When bladder and prostate are normal, the urethral orifice practically lies on the same level as the trigone and the

FIG. 72.—SAGITTAL SECTION OF FIG. 68.

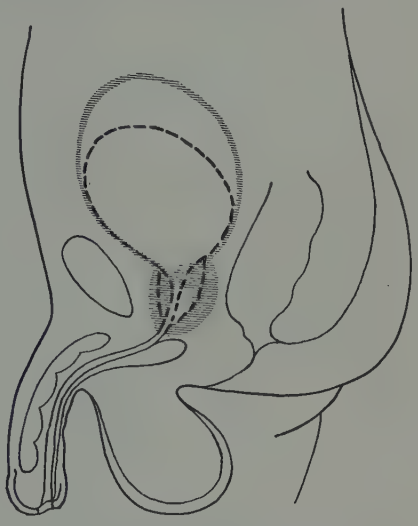

FIG. 73.—SAGITTAL SECTION OF FIG. 69.

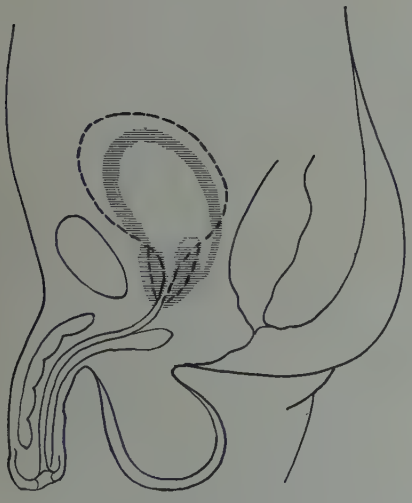

FIG. 74.—SAGITTAL SECTION OF FIG. 70.

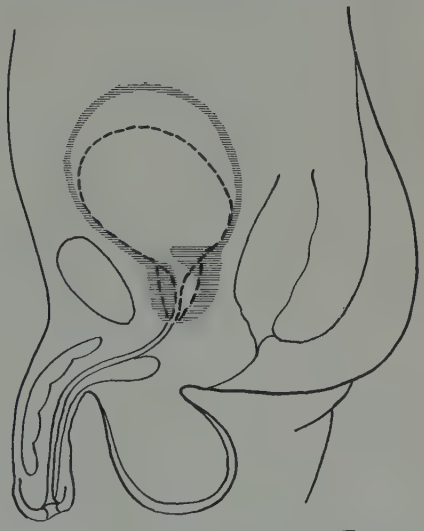

FIG. 75.—SAGITTAL SECTION OF FIG. 71.

floor of the bladder. But every form of prostatism disturbs this relation. If the growth is purely lateral, this lifts a fold of mucous membrane at the urethral orifice (Fig. 68). If there is general enlargement, the prostate projects upward into the bladder, pushing the urethra before it and forming the so-called *bar*

at the neck of the bladder (Fig. 70). The *middle lobe* (Fig. 71) acts in the same way.

3. *The Middle Lobe.*—This term is loosely used to indicate any projection into the bladder, be it bar or pedunculated lobe. Properly speaking, the middle lobe of the prostate is a distinct outgrowth from the neck of the bladder or from the floor of the prostatic urethra (Fig. 71). This tumor springs from the posterior commissure of the gland, and was supposed to originate within it. But Jores [9] showed that "its first beginning occurs in the accessory prostatic glands which lie just under the mucous membrane, and the projection into the bladder is due at first to the hypertrophy of these alone." These outlying glands are usually situated at the urethral orifice "directly beneath the mucous membrane and between the circular fibers of the bladder and the middle isthmus of the prostate" (Alexander [10]). The middle lobe is rarely more than 2 cm. in diameter. It will be observed that some median enlargement is noted in 81 per cent of the tabulated cases.

4. *Lengthening and Distortion of the Prostatic Urethra.*—The prostatic urethra is altered in length, size and curve (Figs. 76, 77). *The urethra is always lengthened* by the increased size of the prostate. But the lengthening of the canal occurs between the verumontanum and the bladder neck and is more on the floor than on the room (Plate X).

The urethra is dilated chiefly by the growth of the lateral lobes which enlarge on each side of it and spread it out on a vertical plane, so that, from being a transverse slit, it is altered to a vertical one, with perhaps a curve to one side or the other, where a projection in one lobe fits into a depression in its fellow of the opposite side. The dilatation may be so great that an ordinary sound can be rotated quite freely within the canal, thus giving the false impression that the bladder has been reached. *The curve of the urethra is lengthened.* That is, its internal orifice is carried upward and backward, and the canal, instead of having the short normal curve, sweeps in a curve of much longer radius, a curve that requires special "natural" catheters with the long curve (Fig. 77). The urethra is further deformed by the presence of the bar, below which the canal forms a distinct pouch, or by the projection into it of tumors from the various lobes, notably the middle lobe.

Sclerosis.—The gross changes imparted to the prostate by sclerosis differ from those of hyperplasia chiefly in that the gland is not palpably enlarged. Rectal touch reveals a prostate that is little, if any, larger than normal. In as much as the posterior lobe is usually not involved, the consistency of the gland may feel quite normal, though it is usually broader, flatter, firmer than normal. It may be distorted by periprostatic scars.

Examination by the urethroscope, however, reveals a slight lengthening of the distance between the verumontanum and the bladder neck, while to pass the latter and insert the instrument into the bladder requires that its ocular end

[9] *Virchow's Arch.*, 1894, cxxix, 224.
[10] *Med. Rec.*, 1899, lvi, 982.

be depressed quite as low as though a middle lobe had to be surmounted, and, when once in the bladder, the instrument lies with its ocular end depressed by the elevation imparted to the tip by the rigid elevated bladder neck.

The essential difference between the obstruction to urination from hyperplasia of the prostate and that from sclerosis is that the elevated bladder neck

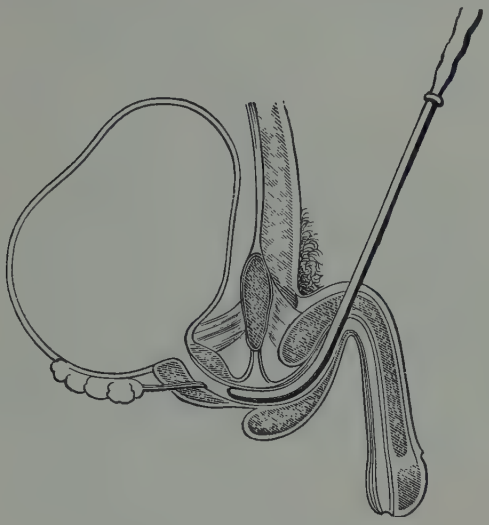

Fig. 76.—Section of Normal Prostate.

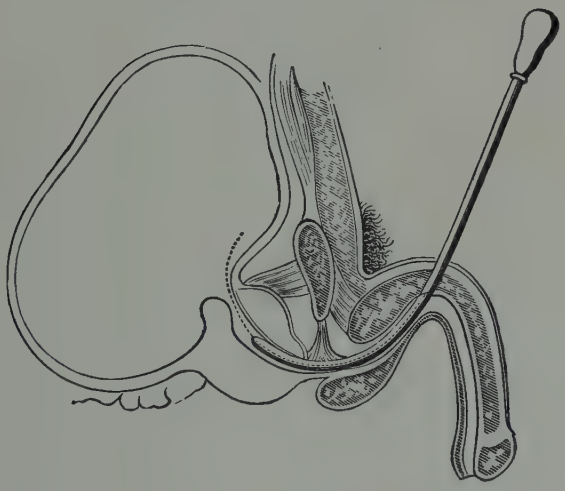

Fig. 77.—Section of Enlarged Prostate.
Compare urethral curves in Figs. 64 and 65.

if hyperplastic is wide open, wider open than normal, while the sclerotic bladder neck is scarred, contracted, sometimes almost tight shut.

Mixed Types.—Sclerosis of the prostate without admixture of hyperplasia is seen almost exclusively in the young. If the sclerosis does not come under

observation until after the patient has reached his fiftieth or sixtieth year, the lesion is a mixture of the two types, hyperplasia occurring in the spared gland tissue. This fact is of primary importance in planning operative relief for such patients. Two clinical types are especially noteworthy:

1. An enlarged, perhaps pedunculated, middle lobe is the only lesion disclosed by examination. The fact that there is no enlargement of the lateral lobes is prime evidence that these lobes, and the bladder neck, are sclerotic. Removal of the lobe without attack upon the sclerosis will not relieve the retention of urine.

2. The condition is correctly diagnosed as sclerosis, but at operation one finds one of both lateral lobes slightly projecting into the urethra. It is no easy matter to enucleate these lobes, for they are sclerosed as well as hyperplastic and very adherent, yet out they must come or the retention of urine will persist.

Pathological Physiology and Secondary Morbid Changes

Retention, Congestion, Inflammation—these are the Fates of the prostatic.

Retention.—The causes of retention of urine are to be found both in the prostate and in the bladder. The prostate is primarily at fault.

In the child the bladder is ovoidal with the sharper end at its neck; it has no floor. But as adult life is reached it settles down into the pelvis. Its trigone becomes more and more horizontal. It acquires a floor. As age advances it tends to sag more and more. In the female it bulges down until it forms a cystocele. But in the male the bladder neck is supported by the urethral and prostatic attachments to the pubes, and, as the bladder sags, it thus tends to pouch behind the prostate, the trigone swings around until it forms the anterior incline of this pouch—the *bas fond,* as the French call it. While there may be some *bas fond* without prostatism, without obstruction of the urethra, such a *bas fond* has no clinical significance. But when there is urethral obstruction and heightened vesical tension at a time of life when the muscles are becoming fibrotic and losing their energy, the result is a relatively rapid pouching of the floor of the bladder, a general weakening of its muscle, and an inability of the organ to empty itself completely. The *bas fond* is never dry; there is always some urine left in the bladder; in short, there is *partial retention* of urine. It is as though the bladder were a tank with the outlet upon one side instead of at the bottom. However often the water is allowed to drain off from the tank none of its contents below the level of the outlet pipe can escape and the tank cannot be completely emptied.[11]

As a result of this vesical derangement, and because of the low vitality of its dilated and inflamed parenchyma, the prostate, compressed by every act of

[11] The mechanism of prostatic retention is not quite so simple as this. The obstruction is not merely the deformity of the bladder neck but also, in the hyperplastic cases at least, the mass of hyperplastic gland tissue that is forced into the urethra with each urinary effort, acting as a sort of compression stopper in the canal.

urination, is very subject to attacks of *acute congestion.* A Christmas dinner, an exposure to cold, a slight alcoholic excess, may bring on acute congestion in a prostate that has given no previous trouble. The patient may have had a little retention of urine quite unconsciously, until some day his acute congestion comes and he cannot pass water. Perhaps he succeeds in relieving himself by dint of hot baths and straining; perhaps his urine has to be drawn from him. The attack may be lasting, or transitory, it may or may not terminate in infection; in any case, it causes a temporary *complete retention of urine,* increases the chronic partial retention, and enhances the effects of this retention upon the

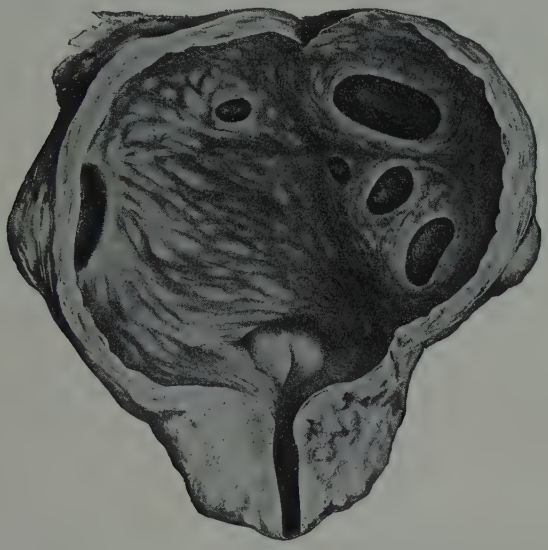

Fig. 78.—Sacculated Bladder.
Due to prostatic retention.

upper urinary organs. And the constant pressure of the retained urine produces in turn a *chronic congestion* of the prostate. And to this *infection* is soon added spontaneously or through the passage of urethral instruments.

The Bladder.—As a result of this retention of urine, the bladder not only changes its general shape but also becomes trabeculated, and even sacculated; while the cystitis causes a gradual sclerosis of the bladder wall, and even a pericystitis. As a final result, the bladder is left atonied or if inflammation predominates over retention in the earlier stages of the disease, the interstitial cystitis may result in pseudohypertrophy. Stone in the bladder is a frequent result of prostatism.

The Ureters and Kidneys.—Dilatation, infection and stone affect the ureters and kidneys, as well as the bladder. With this difference, however, that the renal destruction, though the usual cause of the patient's death, progresses so silently that the victim does not suspect its existence.

CHAPTER XXIV

THE SYMPTOMS, DIAGNOSIS AND PROGNOSIS OF PROSTATISM

SYMPTOMS

In as much as prostatism causes no noteworthy symptoms until it produces retention of urine, the pathological changes in the prostate exist for years before the onset of symptoms; and the prostate may be much enlarged without provoking symptoms, so long as it does not cause retention. Thus, I have seen a man of eighty years of age, with a prostate four times its normal size, whose attention had been only recently called to his urinary organs by the symptoms arising from a secondary stone in the bladder. The presence of prostatism does not imply the existence of symptoms. Furthermore, the small sclerotic prostate may cause all of the symptoms that arise from the large hyperplastic prostate. Indeed, the sclerotic prostate is likely to cause trouble earlier in life, and much more difficult to relieve by operation, than its more familiar hyperplastic fellow.

The symptoms of prostatism are:

1. Symptoms of retention, viz.: Frequent urination; urinary toxemia.
2. Symptoms of infection: viz.: Infection of the upper urinary tract; urinary septicemia; pyonephrosis; prostatic abscess; vesiculitis; epididymitis.
3. Hemorrhage.
4. Sexual symptoms.

Symptoms of Retention.—*Nocturnal Frequency of Urination.*—This is almost invariably the first symptom of prostatism. Even before there is any infection or any notable retention of urine in the bladder the patient has to arise several times at night to urinate. This irritation is usually most marked after 4 A.M., and is due to nocturnal polyuria, the first evidence of renal inadequacy.

Painful and Difficult Urination.—During the hours of maximum frequency of urination, the patient recognizes an obstruction to the flow. He has to wait a long time for it to start, it comes in a feeble stream, and is slow to stop. The more he strains the less he is able to urinate, and he can often only empty his bladder by repetitious efforts.

As the amount of residual urine increases, or infection supervenes, urination becomes painful as well as difficult; frequent by day as well as by night.

Acute Retention of Urine.—As a result of overeating or drinking, exposure to cold and wet or, above all, voluntary retention of urine against the call of nature, the prostate may become suddenly so congested as to excite spasm in the sphincter and acute complete retention of urine. This may be relieved

spontaneously, or by a hot bath, but usually requires the catheter. If neglected, it may kill the patient, or leave him in a condition of overflow.

Overflow.—True incontinence of urine, *i.e.,* the involuntary loss of urine from an empty bladder, does not occur as the result of prostatism. The loss of urine that does occur is overflow from the overdistended bladder. This overflow is usually associated with irritation of the bladder, so that the patient urinates whether he will or no at least once an hour, perhaps oftener, and between urinations, especially during the night, he loses urine involuntarily.

Symptoms of Changes in the Upper Urinary Organs.—As a result of infection and dilatation of the bladder and the kidneys, the patient suffers from urinary toxemia, or urinary septicemia. His frequency of urination is increased by cystitis and stone in the bladder, and by the polyuria of renal dilatation.

Inflammatory Complications.—See page 241.

Hemorrhage.—*Bleeding is much more common from prostatism than from prostatic carcinoma.* The bleeding is due either to an ulceration on the surface of the prostate itself, or to secondary stone in the bladder. It may be of that profuse quality so suggestive of malignant neoplasm; it may occur quite independently of the passage of instruments.

Sexual Symptoms.—The combination of age and disease usually diminishes or obliterates sexual power and desire. Exceptionally, however, the congested prostate excites abnormal erections which may drive the patient into neurasthenia, or into all sorts of sexual excesses. Such symptoms appear, if at all, before there is any notable obstruction to urination.

ONSET OF THE DISEASE

While the first symptom of the prostatism for which the patient consults a physician may be hemorrhage, a prostatic abscess, some sexual disturbance, or some other relatively unusual manifestation, the symptoms usually begin in one of three ways.

The Usual Type.—The symptoms begin with nocturnal frequency and difficulty of urination. This increases gradually and the patient passes on through the first, second and third stages of the disease as described below.

The Acute Complete Retention Type.—Acute complete retention of urine may supervene at any moment in the course of the disease. It is the first symptom of importance in almost half the cases.

If promptly treated it may sometimes be relieved, and the bladder resume its ability to empty itself satisfactorily. But if the infection cannot be controlled, or if some residual urine remains, the acute complete retention will soon recur. Very few patients with acute complete retention escape further trouble within the year. Yet they may escape for a number of years without any further symptoms.

Urinary Toxemia.—The patient with a tolerant uninfected bladder may never have an acute complete retention of urine and may not concern himself

about his gradually increasing frequency of urination. He may thus reach a condition of chronic distention of bladder and kidneys without consulting a physician. Under such circumstances the first condition that he notes is a *loss of weight and strength, accompanied by constipation and dry mouth.* Even these he may not note until a slight infection adds fever to his symptoms. Such patients, unless carefully examined, may be treated for digestive disturbances for a considerable time; though the mere laying of a hand upon the lower belly identifies the distended bladder and intelligent investigation of the patient's history reveals polyuria, frequency of urination and dry mouth.

FIG. 79.—SILENT PROSTATISM.

The patient is lean, constipated and sleeps and digests badly. The bladder is distended to the umbilicus. The dangerous type to operate upon.

COURSE OF THE DISEASE

The course of the disease is divided into three periods: The period of congestion; the period of partial retention; the period of complete retention. The two former may be introduced or interrupted by attacks of acute complete retention. Hemorrhage or infection may occur at any time.

1. **Congestion.**—During this period there is little or no retention of urine, but only a slight nocturnal irritability of the bladder with nocturnal polyuria and perhaps attacks of prostatitis or of sexual irritability amounting almost to priapism.

2. **Partial Retention.**—The passage from congestion to partial retention, unless marked by an acute retention, is quite insensible. Residual urine begins to accumulate in the bladder, as a result not of an enlargement of the prostate, but of weakening of the bladder muscle. The patient merely notes an added frequency of urination or, if infection occurs, a cloudy or malodorous urine, while the difficulty and pain in the urinary act increase and become diurnal as well as nocturnal. The limit of incomplete retention, both as to time and quantity, are quite indefinite. The patient who retains a pint of urine and yet has to pass water only every three or four hours and empties out six or eight ounces of urine each time cannot, strictly speaking, be said to be in a state of chronic complete retention. As

a rule, however, by the time the patient's retention amounts to 250 c.c., his urinary calls are so frequent and the amount he passes so small that his bladder may be said to be full all the time. He is in the third stage of the disease, the stage of urinary hypertension. Indeed, exceptionally the contracted and inflamed bladder will hold no more than 50 to 100 c.c. The least retention completely fills such an organ.

3. Complete Retention.—Chronic complete retention usually implies frequent urination, every hour or less, the passage of small quantities, about 50 c.c., and is always associated with dilatation of, and usually with infection of, the ureters and kidney pelves. If neglected the patient is unable to control his urination and is more or less constantly wet as the result of his involuntary overflow. Exceptionally the increase in back pressure is so gradual and the patient so unusually unfortunate that he reaches a great distention of the bladder without any increase in frequency of urination. The external appearance of such a patient is characteristically that shown in Figure 79, the man lean, the bladder distended. Internally the prostatic enlargement is usually found to be slight. Clinically the renal function may seem perfect at the time of the examination but the least disturbance by catheter of the established pathological intrarenal pressures wrecks the renal function and may kill the patient within a week. These apparently healthy patients are the ones that require the most meticulous decompression to carry them through the emergency.

Inflammatory Complications

While the above description applies to many cases, the progress from one stage to the next may not be so orderly. Appropriate treatment may carry the patient back from the stage of partial retention to that of mere congestion, or back from complete to partial retention; or an isolated acute retention may be relieved and be followed by a long interval, even an interval of several years, during which the patient suffers not at all, and there is no retention whatever.

The inflammatory complications are, however, the chief agencies in modifying the course of the disease. These complications occur sooner or later in every case, and once the inflammation has set in it is almost impossible to get rid of it. *The inflammation is usually due to catheterism.* Spontaneous infection does occur, but the complication is the expected result from necessary local treatment.

Inflammation of the Prostate.—*Chronic prostatitis* is present in every infected case. *Abscess and periprostatitis* are relatively uncommon. *Seminal vesiculitis* is common and usually unimportant.

Epididymitis.—Epididymitis may occur in acute attacks, spontaneous or following instrumentation, or it may appear as a sluggish, chronic induration at one end of the epididymis, with occasional subacute or acute attacks of recurrent inflammation. The epididymitis of the prostatic is especially prone to suppuration.

Cystitis.—Inflammation of the bladder is the most common complication of complication of prostatism. The cystitis is usually due to catheterism, less frequently it is spontaneous. When due to the catheter, it usually begins acutely, often with a chill, while spontaneous cystitis is commonly chronic from the outset. Although the type of the inflammation may be severe throughout, the cystitis of prostatics is often of a mild and superficial type for many months, not causing any great pain or frequency of urination, or, at any rate, easily controlled by local treatment. The cystitis may be alkaline or acid.

Pyelonephritis.—No prostatic can have cystitis for any length of time without extension of the inflammation to the kidneys. The pyelonephritis often remains for years a mild inflammation, recognizable only by a careful urinary examination; but, mild as it is, this inflammation is an aid to the urinary pressure in its work of debilitating the kidneys and slowly leading to the patient's death, and pyonephrosis, requiring nephrectomy, is occasionally encountered.

Stone.—The prostatic is peculiarly subject to stone in the bladder. Urate stones frequently complicate prostatism with but little retention and slight infection. If removed by litholapaxy they recur repeatedly until the prostatic obstacle is removed. On the other hand severe ammoniacal cystitis is often a sign of phosphatic stone.

Hematuria, severe cystitis, and diurnal frequency of urination may suggest the presence of stone; but if this lies behind a large prostate it often does not irritate the bladder neck and its presence is not suspected until disclosed by cystography, cystoscopy or operation.

DIAGNOSIS

Rectal Examination.—When a patient over fifty years of age complains of frequent micturition, suspicion falls at once upon the prostate. It is rare that stricture causes trouble for the first time so late in life, and even rarer for prostatic retention to occur earlier. As the first step in the examination, a digital exploration should be made through the rectum. By this means alone prostatic hyperplasia can be demonstrated. In place of the soft, chestnutlike body, hardly recognizable except by the skilled touch, the finger encounters a rounded, dense mass, smooth and usually symmetrical. The median fissure between the lobes may be more than usually perceptible, or may be wholly obliterated; while the finger passed up on each side, between the prostate and the walls of the pelvis, recognizes a deepening of the sulcus, an undue prominence in size of one or both lobes, an enlargement of the gland both from side to side and from above downward. If very large, it may be impossible to hook the last phalanx above it.

If only the median lobe is enlarged, or if the prostate is sclerotic, rectal examination often reveals no positive evidences of this enlargement.

Hypogastric Palpation.—If the bladder is distended with urine, an oval tumor is found, filling up the lower part of the belly, perhaps as high as the umbilicus, flat on percussion, and causing a desire to urinate when pressure is

made upon it. This tumor, formed by the overdistended bladder, may sometimes be plainly seen, but the patient is usually unconscious of its existence. The full bladder may be palpated between a finger in the rectum and a hand on the hypogastrium.

The Urine.—The patient is now asked to stand up and to pass water into a glass vessel. As the urine flows the sluggishness of the stream is noted.

If there is complete retention, the urine will not flow at all, or comes only by drops. If the patient strains, the stream, instead of becoming larger or flowing with greater force, is diminished in size and power. If the bladder be inflamed, there may be severe tenesmus and pain during the attempt to urinate, and the rectum may protrude or feces be passed during the act. Hernia may also result. At the end of urination the stream gradually dribbles away in drops, and the final jet is wanting.

If the urine be now held up to the light, its cloudiness or limpidity proves an index to the presence or absence of infection.

Catheterism.—If the urine passed is purulent, or if no urine can be passed, the quicker the patient is catheterized the better. But *if the urine contains no pus, infection will follow catheterism.* Hence the operation in such cases should be guarded by the most minute precautions, viz., decompression, gentleness, antisepsis.

The choice of catheter is important. A smooth soft-rubber instrument will usually enter the bladder, but not always. A "natural curve" woven catheter will enter the bladder of any prostatic whose condition is not complicated by previous efforts at instrumentation, or by carcinoma, stone or stricture. No force should be employed in introducing the instrument. Dexterity and patience will succeed where brute force will only light up inflammation or open a false passage.

The amount of residual urine measures, in a general way, the amount of retention, though this must be repeatedly verified.

The urethral length is also measured by the catheter. One usually feels the resistance of the cut-off muscle very plainly in entering, and if the urethral length is not increased, one expects to strike water 5 to 6 cm. beyond. Hyperplasia increases this by 2 to 5 cm.

Precautions.—1. If the patient's bladder is full, whether in acute or chronic retention, the passage of a catheter is a therapeutic, not a diagnostic measure, and should be surrounded with all the precautions of decompression. (See Chapters XI and XXV.)

2. There are certain conditions of chronic non-gonorrheal prostatitis that contra-indicate catheterism. The patient complains of great frequency of urination and may or may not have fever. The expert examiner is struck by the marked irritability of the bladder in contrast to the absence of any great retention. The urine may be grossly or only microscopically purulent, the prostate is tensely swollen, *abnormally sensitive,* and its secretion purulent. The introduction of even a soft rubber catheter is unduly painful, the residual

urine obtained is usually not above 50 c.c., the result of the catheterism is a marked increase in the irritability of the bladder and of the amount of pus in the urine, fever, even chill. I have known the resultant fever of such a patient, refusing operation, to relapse for three months!

Further catheterism is absolutely contra-indicated. The condition must be treated as an acute prostatitis. Should the kidneys suffer from the effects of the retention, two-stage prostatectomy should be performed in preference to catheterism.

3. Some 10 c.c. of a non-irritating antiseptic such as argyrol, 5 per cent, or acriflavin, 1:1,000, should be left in the bladder at the close of diagnostic catheterism, if the bladder is uninfected. If infected, catheterism should close with an antiseptic irrigation.

Cystoscopy.—None but the expert should attempt to cystoscope the prostatic. The operation is dangerous to the patient and is calculated to give him little information. Cystoscopy is an essential preliminary in perineal prostatectomy, for without it the shape of the prostate cannot be studied. But the suprapubic incision permits a visual examination of the interior of the bladder calculated to disclose the shape of the prostate as well as any complicating bladder diverticulum, tumor or stone as accurately as cystoscopy. Therefore the only advantage of cystoscopy preliminary to suprapubic prostatectomy is that it minimizes the emergency decisions the surgeon will be called upon to make at the time of operation. Hence the surgeon will employ it only when he feels that this advantage outweighs the dangers of the cystoscopy.

Braasch employs preliminary cystography as a routine, thinking it safer, as a routine clinic procedure, than cystoscopy.

Urinalysis.—The urine should be inspected after being passed in two glasses, and submitted to a routine examination.

Renal Function Tests.—The renal function should be tested as a routine measure. The power of concentration may be summarized by the examination of specimens of day and night urines. The phenolsulphonephthalein test should never be omitted and if a low return is obtained after intramuscular injection, this should be controlled by a careful intravenous injection. These estimations must be made upon specimens of urine obtained by catheter. Estimation of nitrogen retention in the blood are required when the phthalein output is low, and when operation is imminent.

Other Methods of Examination.—According to the information obtained, we examine the patient still further—palpate the kidneys, submit him to x-ray or ureteral catheterism, or to various renal function tests. For the fact that the prostate is large is of course the least important feature of the picture. The condition of the patient's bladder is more important than that of his prostate; the condition of his kidneys more important than either; the condition of his general health most important of all.

Differential Diagnosis

When a patient over fifty years of age complains of nocturnal frequency of urination we mentally set him down as a prostatic. Yet the inference is by no means strict. Surely two out of five cases of nocturnal frequency are due to other causes, such as nocturnal polyuria, prostatic carcinoma, or urethral stricture. The average prostatic begins to suffer between fifty-five and sixty-five, and first consults a physician at about the latter age. The patient who does not begin to suffer until after he is seventy years old usually has carcinoma. Moreover, it is not to be forgotten that occasionally sclerotic retention occurs in young men, even in infants.

Careful physical examination rules out such conditions as stricture and nocturnal polyuria. But four conditions causing the symptoms of prostatism are very commonly confused. Indeed, it may for a long time be difficult in a given case to make the diagnosis absolute among them. These conditions are:

Prostatism (hyperplastic or sclerotic)
Prostatic neoplasm
Paralysis of the bladder
Prostatic calculus

When there is retention of urine, but no urethral stricture, and no palpable prostatic enlargement, the following possibilities must be contemplated:

1. There may be paralysis of the bladder. This is commonly due to tabes, shows a rather suggestive cystoscopic picture, and is distinguished by reflex changes, the spinal fluid changes, the open vesical orifice and the lowered bladder pressures.

2. There may be carcinoma. To distinguish prostatic sclerosis from prostatic neoplasm always requires careful rectal examination, sometimes cystoscopy or cystogram, as described in Chapter IX. Spontaneous hemorrhage is suggestive of prostatism rather than of malignancy.

3. There may be a pedunculated middle lobe or a bar, visible by cystoscopy and tilting the cystoscope.

4. Rarest of all, and oftenest in relatively young men, we encounter the type of sclerotic prostate that shows no characteristic change to cystoscopy, excepting the closed urethral orifice. The existence of this condition can only be affirmed after tabes has been excluded by the most rigid tests. Tilting of the cystoscope is the most reliable positive sign.

Prostatic Calculi.—In as much as prostatic calculi may give no subjective symptoms at all, or may produce only a vesical irritability, while for objective sign they cause enlargement of the prostate, it is quite possible to mistake calculi for prostatism. Yet I have not known this to be done; indeed, the irregular outline of the prostate containing many calculi is usually such as to suggest neoplasm rather than prostatism.

PROGNOSIS

In the First Stage.—In as much as the majority have no symptoms at all, and an indefinitely large proportion of others have only slight symptoms for many years, one may be optimistic about the prospects of the prostatic who is seen in the first stage of his disease.

About 50 per cent of prostatics have acute retention, and the great majority of these reach chronic complete retention within five or six years. On the other hand, I have followed one case fourteen years, from his single acute prostatic retention, and seen no return of symptoms. A number of other cases I have followed more than five years. The younger the case, the slower the average progress of the disease. The prostatic who begins to have symptoms at or beyond the age of seventy usually reaches chronic complete retention within two years.

In the Second Stage.—When the patient is in chronic incomplete retention, his prognosis is gradual failure of the bladder and passage to chronic complete retention more or less rapidly, according to his age, his infection, the shape of the prostatic obstruction and the irritability of the prostatic urethra.

In the Third Stage.—When the patient has reached chronic complete retention, his expectation of life depends upon his treatment. The patient who refuses operation and neglects himself speedily comes to grief. The patient who takes care of himself may come to grief by unavoidable accident. But the passage of the catheter to empty a bladder in retention is not in itself necessarily fatal. Indeed, the patient who empties his bladder three or four times a day by means of the catheter is in no worse condition than the patient who empties his bladder the same number of times without a catheter, excepting only that the passage of the instrument is more or less irritating. In this the patient with hyperplastic prostate is badly off. We all are familiar with tabetics who have kept in excellent health for years, depending wholly upon the catheter for drainage, upon hexamethylenamin and ordinary cleanliness for antisepsis. The sclerotic prostate stands catheterism less well, for each passage of the instrument traumatizes the rigid bladder neck. The hyperplastic prostate is the worst of all. Its possessor must usually choose between operation and death by torture within a few months of the time he begins to pass the catheter.

Prognosis as Regards Infection.—The prostatic who constantly passes the catheter is doomed to infection in spite of whatever precautions he may take. Aseptic rules of catheterism are solely for the purpose of making this infection as mild as possible. The infection always occurs within a month or two, usually within a week or two, of the beginning of catheterism. We look for it and are happy to see it pass, since it establishes the patient in a condition which either is, or may usually be reduced to, a mild acid infection.

The larger the prostate, the more likely is the infection to be difficult to control. Careful patients with paralyzed bladders and complete retention with-

out enlargement of the prostate do much better, as a rule, than prostatics; for the prostate is a constant source of infection and trauma.

Infection of the kidneys and ureters establishes itself at about the same time as infection of the bladder. It is quite as difficult to dislodge.

Prognosis as Regards Kidneys.—Most prostatics who are not relieved of their retention by operation die by urinary septicemia with pyelonephritis. The issue may be rapid or slow. Watson collected 207 cases of prostatism treated by the catheter, with a little less than 8 per cent mortality within a month. The subsequent prognosis as regards the kidneys depends upon so many items that a general summary of them is impracticable. The patient who elects to take his chances with the catheter rather than with operation is merely putting off the evil day, submitting himself to various woes to which operation will ultimately be added under circumstances not as favorable as when the urologist is permitted to elect the time for operation. Even more than the patient who refuses operation at or immediately after his first attack of appendicitis, the recusant prostatic is gambling on the slim chance that he can remain indefinitely in a state of unstable equilibrium.

CHAPTER XXV

TREATMENT OF PROSTATISM

The prostatic man resembles the menstruating woman in that any exposure or overdoing reacts promptly upon his pelvic organs. "Beware of congestion" must be his motto, and upon this he must mold his life. He must avoid all exposure to cold: drafts are dangerous, wet feet fatal. His clothing, especially his underwear and footgear, must be regulated by the thermometer. Light exercise and fresh air are beneficial; but any excess—physical, mental, sexual, or alcoholic—must be avoided. The stomach must not be overloaded. *"C'est souvent en lui souhaitant bonne fête,"* says Guyon, *"qu'on détermine chez un viellard prostatique sa première rétention."* The diet must be both light and laxative, for a torpid bowel threatens infection as well as congestion. Meats should be largely replaced by vegetables and cereals. Finally, the patient must drink plenty of water, five to eight glasses a day.

GENERAL TREATMENT

During the first stage of the disease the bladder empties itself at least within 25 c.c. or so. Catheterization is therefore quite unnecessary. Indeed, it may be quite harmful. Even if the urine is clear, there is likely to be some infection of the prostate and the passage of a catheter over this infected gland may excite an acute prostatitis, an immediate considerable increase in the amount of urine retained and operation may be required at once. Therefore it is wiser, if bimanual palpation reveals no gross retention, to endeavor to alleviate the symptoms by massage of the prostate. One notes the amount of pus and bacteria thus obtained and a catheter is not passed until it is proved that this treatment gives no relief. Sometimes the administration of alkalis or of sandalwood oil and the encouragement that the patient feels because he is not immediately threatened with operation, suffice to alleviate the symptoms and to defer operation indefinitely. But before postponing operation, a complete examination, including blood chemistry, should be made. The phenol-sulphonephthalein test is of course inaccurate if a catheter is not passed to empty the bladder.

Patients in the second stage of the disease with constant residual urine above 50 c.c., and with frequency of urination or nitrogen retention, require operation.

Congestion.—Prostatic congestion with negligible retention and characterized by an undue sexual or vesical irritability, should be controlled without local

treatment, if possible, by correcting sexual or other eccentricities that are at the bottom of the trouble, and by the administration of balsamics, alkalis and sedatives.

If the irritation persists, local treatment may be undertaken, but only with the consciousness that a single passage of soft-rubber catheter upon such a patient has often excited an infection, perhaps hitherto latent and not therefore to be prevented by any cleanliness in the operation, that led rapidly through a few days of exquisite torture to operation under the most unfavorable circumstances—an oversensitive patient, a recent infection, catheterism impracticable, etc.

With this fear the local treatment may be gently begun by the passage, after anesthetization, of a 20 F. sound until its tip but not its shaft reaches the bladder, followed by the instillation into the posterior urethra of a few c.c. of 5 per cent argyrol. The argyrol may be repeated daily, the sound once a week and prostatic massage of the gentlest description once a week, alternating with the sound. Later the argyrol may be increased to 10 per cent or replaced by acriflavin or instillation of two drops of 1:200 phenol. Perineal diathermy may help. Local treatment may be persisted in only on condition that it succeeds.

Opiates.—A final word on the subject of opiates. Prostatism is a chronic disease and pursues a most uncertain course. The sufferer, writhing in agony to-day, may be entirely relieved to-morrow. The patient whose last sun seems to have risen may be relieved by operation and survive for many a year. Under these circumstances, it is scarcely necessary to insist that opiates should be administered with extreme caution. The patient, a constant sufferer from a tormenting disease, is in an ideal condition to become addicted to narcotics. I have seen few sadder cases than those of old men whose prostatic disease was still curable, while their subjection to narcotics could not be overcome.

TREATMENT OF RETENTION

Much the most difficult question in regard to the treatment of prostatic retention is when to begin treatment.

Most prostatics suffer some nocturnal frequency of urination due to a slight retention of urine for some months or years before their symptoms become important enough to bring them to the physician. Such patients as consult us during this period should be advised for or against operation chiefly on the basis of the size of the prostate. The cystoscope should never be employed for fear of exciting acute retention or infection. But if rectal touch reveals a prostate that is scarcely enlarged and the residual urine does not reach 50 c.c., the treatment should, if practicable, be confined to the relief of congestion and the diversion of the patient's mind from his symptoms for (1) minor retentions are sometimes not relieved by prostatectomy, (2) minor enlargements of the prostate are not easy to enucleate and even if removed leave behind portions

of the gland in which further hyperplasia will occur. Hence *prostatectomy may never be advocated as a prophylactic against symptoms not already present.*

Still another class of patients is those in whom a general prostatic enlargement is discovered either in the course of a routine examination upon a patient with no urinary symptoms beyond getting up at night once or twice or with an acute retention of urine which has been relieved, let us say, by the single passage of a catheter. Collateral circumstances should determine the treatment of such a case. He may go on for years without grave symptoms or he may be in trouble in a week. If he can keep within observation and will obey the dictates of prostatic hygiene, he may be permitted to go for a time without operation. But most of these old men are so unreliable that they cannot be trusted.

As the community is becoming aware of the benefits of prostatectomy, we more and more frequently encounter cases of an intermediate class with no great enlargement of the prostate or deficiency of the renal function but an annoying frequency of urination with retention of urine so slight that perhaps it cannot be certified. Yet, rectal examination may, and cystoscopy does, reveal a slight enlargement over the prostate. An enlargement similar to what we see in many patients without symptoms and which we do not for a moment consider merits treatment.

Such patients should be cystoscoped with an instrument less than 20 F. in size. I believe that caudal anesthesia greatly reduces the trauma of cystoscopy. After the enlargement of the prostate is thus identified, one feels that removal of the obstruction would doubtless relieve the symptoms. Yet the symptoms are not grave and a classical prostatectomy (unless we follow the example of Wildbolz and remove the whole prostate) will doubtless fail to remove obstructions that have not yet developed and which will recure to plague the patient in the course of the next five or ten years.

I believe Caulk has suggested a solution of this difficulty. By means of one of the palliative operations, of which the best are doubtless those of Caulk or Collings, the minor obstruction is removed at no great inconvenience or danger to the patient, the symptoms are relieved temporarily and though we may foresee the possibility of their recurrence after an interval of years, we cannot prevent this. I do not follow Caulk in his plea for repeated palliative operations as a substitute for prostatectomy.

But when the prostate is definitely enlarged in both its lateral lobes, the situation is reversed. It is then a kindness to the patient to advise prostatectomy as a prophylactic against greater ills. The patient with partial retention, who accustoms himself to the occasional use of the catheter should be urged to submit to the dangers and discomforts of operation, both of them being less than those of the catheter. He may point to John, who has lived ten years in "catheter life," and to James, who died within a week of operation. The answer, "My patients do not die after operation," is neither true nor discreet. The fact is that there are a hundred men alive and well to-day after a prosta-

tectomy performed ten years ago for one who has gone as long under the catheter, and that the majority of those who perish from operation do so because they have too long delayed the operation. Many a man has borne joyful witness after operation that the catheter brought him more woes than the knife. Indeed, the surgeon himself fears both the pain and the peril of preparation for prostatectomy far more than he does the operation itself.

In every properly organized clinic the mortality among prostatics before prostatectomy is greater than that after prostatectomy, thus proving that even in the most skilled hands the catheter is more dangerous than the operation.

Catheter Infection.—To prevent infection when the catheter is being used would be ideal. But it cannot be done. General antisepsis by hexylresorcinol is impracticable because water must be forced. Indeed dilution, by diluting the bacteria, is our main support. Even hexamethylenamin is of little value because of the necessary dilution, and because the cases that most require antisepsis are treated by the indwelling catheter which carries the urine from the bladder before the drug could have time to develop its antiseptic properties. We await the ideal general antiseptic.

Local antisepsis and gentleness go together. Instruments must be smooth, boiled, gently introduced. Antisepsis must be unirritating and for this reason the injections must be made as rarely rather than as frequently as possible. The urinary tract is surely doomed to be infected when operation opens widely the communication between bladder and skin: it will doubtless be infected by indwelling catheter even before operation. There is every reason therefore not to insist too fiercely on the adequacy of local antisepsis, but rather upon the necessity for gentleness, careful management of the indwelling catheter and irrigation both by diuresis and by some mild antiseptic locally. The object of treatment is that the inevitable infection should be restricted to the inevitable colon type and that good drainage should prevent acute attacks of renal or prostatic suppuration.

The mechanics of local treatment are therefore far more important than their chemistry. Until local infection occurs it is as well to attempt no local antisepsis. Thereafter the wash usually employed is potassium permanganate or silver nitrate, 1:4,000. But even after operation, massage and dilatation usually do more than antisepsis.

Is cystoscopy or cystography preferable before prostatectomy? Braasch recognizes cystography as an adequate substitute for cystoscopy to eliminate the possibility of unforeseen complications such as tumor or stone in the bladder. This is a wise provision for clinic work since it is difficult to control the gentleness of the cystoscopist. In my private practice I always take a preliminary x-ray and sometimes a cystogram but unless the patient is unusually sensitive or the prostate so large that the cystoscopy would only explore the vault of the bladder, I prefer to perform a preliminary cystoscopy using an instrument of 20 F. caliber that will take one No. 5 ureter catheter and has a shaft 3 cm. longer than the normal.

Acute Retention.—The urine must be withdrawn. Half-hearted measures are damaging as well as inefficient. The patient may be able to pass his urine in a hot sitz-bath; but if the physician will only be gentle he will give more relief with less danger by the passage of a 14 F. soft-rubber catheter or "natural curve" woven catheter. In order to minimize the prospects of infection, not only must the instrumentation be brief with the utmost gentleness but also it must be followed by the injection of a small quantity of an unirritating antiseptic solution. I prefer acriflavin 1:2,000. Mercurochrome 1:200 may be employed. I question the value of argyrol or boracic acid. Silver nitrate and potassium permanganate are unduly astringent.

The few hours following the first passage of a catheter for acute retention are the most important in the patient's disease. Relief of the retention releases a profuse polyuria. Do not think that the bladder will take eight hours to refill. It will be full again in from two to four hours and if, at that time, the patient can pass his urine, all is well. He needs only to be watched carefully for signs of a recurrence of his retention and to be given hexamethylenamin, at least 2 grams a day, and plenty of water. He may go ten years before his next retention but is far more likely to enter soon again into retention. The second retention should be the signal for preparing him for operation. Or if he does not shake off the first retention satisfactorily and continues to have an irritable bladder, some retention of urine or a beginning infection, he had better be made ready at once for operation.

Preparation for Operation.—If he is a hospital case or if the physician does not foresee the possibility of returning in two or three hours to relieve a continuation of the acute retention, then there is no alternative; a catheter must be tied into the urethra in order to establish continuous drainage at once. If the retention has been brief, no decompression need be employed, but if it has been either intensely acute or somewhat prolonged, the bladder must be decompressed in accordance with the theory laid down in Chapter XI. Previous to decompression it is customary to tie off the vasa deferencia in order to prevent epididymitis. I now practice a preliminary prevesical section at this same time.

Technic of Decompression.—The apparatus consists of a quarter-inch tubing long enough to extend from the patient's hips to the head of the bed, at one end of which a Y-glass tube is inserted, at the other a glass connecting tube, of even caliber throughout (not with a vile wee hole at one end to get plugged with pus) to connect it with the catheter, also an irrigating tank or similar vessel which can be lashed to the head of the bed. From one leg of the Y-tube another rubber tube leads to the tank.

The long rubber tube is filled with sterile water or salt solution and clamped. The Y-tube is lashed to the head of the bed. The catheter is clamped, introduced into the bladder, attached to the tube full of water and then unclamped. There will be an immediate rush of urine from the bladder through the tube into the tank, taking off the greater part of the immediate pressure and making the patient comfortable. But if the bladder has been palpable at about the level

of the umbilicus before the decompression apparatus was attached, it will be found to have descended no great distance toward the pubes. Have the Y-tube elevated 6 to 8 inches above the level of the patient's body as he lies in bed. This elevation may profitably be kept up for at least twenty-four hours and thereafter the Y-tube, which makes the water level, may be lowered to about the level of the patient's body. At this point the decompression amounts to little but the slight elevation of the water level and the friction within the tube itself keeps an ounce or two of fluid in the patient's bladder and prevents its grinding down upon itself in the spasm of strangury. This is antispasmodic decompression, the bladder splint.

How long this slight antispasmodic decompression shall be continued will depend upon the reaction of the patient's general condition. The blood chemistry and the blood-pressure are taken every other day and decompression kept up until these have fallen to a fixed minimum.

Young has advised a complicated apparatus for decompression whereby the occasional aspirations of the bladder draw into it an antiseptic. This he feels sometimes assures an absence of infection. We may, however, always look for infection in the urethra as the result of the presence of the indwelling catheter and we may be sure that the prostate is involved in this infection. The advantage of insisting upon irrigation is not clear. Drainage is the patient's protection.

It may be asked why the old-fashioned drainage over the side of the bed is not perfectly adequate to prevent spasm. The reason is that it leaves the bladder empty. The fact is that many lives are saved by decompression that would otherwise be lost.

During the course of decompression and throughout the preparation for prostatectomy, the patient should absorb at least 3,000 c.c. of fluid a day. If the stomach rejects the fluid, the duodenal tube may help immensely.

If the tongue is dry or the blood chemistry remains high and the patient cannot take enough fluid by mouth, the fluid should be given him either under the skin or into the vein.

Fluid by rectum is relatively inefficient. Any attempt at antisepsis by mouth is scarcely worth while.

Morphin by hypodermic is often needed to carry the patient over the first twenty-four hours. No hesitation need be felt in giving the first few hypodermics of morphin. They do not perceptibly interfere with kidney function. The chief evil effect of morphin is the disturbance of digestion following its repeated administration. I question whether any of the substitutes for morphin have any great advantage in this respect.

While the decompression is being carried on the opportunity will be taken to study the action of the heart, by cardiograph, to take one or more blood-counts and chemistries and to familiarize one's self by repeated physical examination and urinalyses with the patient's renal and general condition.

Decompression is no longer necessary when blood-pressure, blood chemistry

and phenolsulphonephthalein output are stabilized and diuresis established. If the decompression fails, either because the patient cannot bear the retained catheter, or because it is inadvertently pulled out from time to time, or gets blocked with pus, then the only relief is by suprapubic cystotomy. This should be performed under local anesthesia and with the greatest deliberation. The tube inserted should be the smallest possible that is qualified to carry off the pus or blood-clots that may accumulate in the patient's bladder. The tube must be sewed tight into the bladder wound by a purse-string suture and the bladder inverted around it so as to make a water-tight junction in order that this tube may continue the antispasmodic decompression which has failed by urethra. The farseeing surgeon will perform prevesical section.

When Is a Patient Ready for Prostatectomy?—Not until his symptoms have been relieved and his condition stabilized with blood chemistry, water output, urea and phenolsulphonephthalein excretion, blood-pressure, temperature and heart action all stabilized at the best attainable point.

The only heart tonic worth considering, except in emergencies, is exercise. Unless the patient is in perfect general health he is not ready for prostatectomy until he has convalesced from all preparatory measures to such a degree that he can and does daily walk at least half a mile without becoming exhausted. This he can do perfectly well while carrying a urethral catheter or a suprapubic tube and it is a most essential part of the preparation for prostatectomy. No drug will replace exercise.

Digitalis is a treacherous drug to use on prostatics. The gravely impaired renal function so slows down the excretion of the drug that the ordinary rules of digitalis saturation do not apply. The patient becomes digitalized with half the usual dose.

Persistent or recurrent fever is one of the best reasons for exchanging urethral drainage for suprapubic drainage. The source of the temperature is not always clear. Obscure infections are attributable to prostatic suppuration or to renal suppuration from ureteral reflux, either of which situations is relieved by the exchange of urethral catheter for suprapubic tube. But the prostatic is not immune to pneumonia or perinephritic abscess.

A continuous or recurrent fever, therefore, requires suprapubic drainage and if the fever continues in spite of the drainage and one fails to find a prostatic abscess or perinephritic abscess or other localized focus, the patient should be treated for sepsis by overeating, diuresis, transfusions and heliotherapy until the fever abates.

Choice of Prostatectomy.[1]—If the published statistics of a surgeon were any criterion of the danger attached to putting one's self in his hands for operation, perineal prostatectomy and the two-stage suprapubic operation would vie with each other on even terms. Every so often some one reports a hundred

[1] Certain operations, such as the complete perineal prostatectomy of Wildboltz for hyperplasia, have not been sufficiently tried out in the United States for us to weigh their merits fairly. They are therefore not discussed here.

consecutive prostatectomies by one or the other method without a single death, a refinement beyond which it seems indelicate to peer. It is true, one of these perfect ones confided to me that in the next twenty-five cases after his hundred published successes he lost three—and did not publish them. But one has no right to protest at this. Even the statistician should be permitted to be human in spots. What we do protest is that the hundred successive successful prostatectomies are made possible only by killing off many of the bad risks before operation. It is well known that if one includes all cases as failures who are refused operation, who die during the preliminary drainage, or of the prostatectomy, whether immediately or ultimately, the total mortality of prostatism is about 20 per cent. The mortality from prostatectomy depends upon two gross factors, the urological knowledge—far more than the operative skill—of the surgeon, and the age of the patient, if we interpret the word age in a somewhat physiological sense. My only boast, for example, is that I have never lost a patient after an operation for sclerosis of the prostate. For the sclerosis attacks younger men, as a rule, and when I see an octogenarian with sclerotic retention, I am rather moved to let him die in peace.

The choice of operation should therefore be made on a basis somewhat independent of operative statistics. The urologist should, and will, select the operation that gives him the best results; we cannot interfere with that. But the student should be taught that operation with which he will probably save the greatest number of lives. He should therefore be taught primarily the two-stage suprapubic prostatectomy, for this is the safest in inexpert hands. After he has become familiar with the various reactions to the stages of preparation leading up to two-stage prostatectomy he may attempt prostatectomy without preliminary suprapubic drainage. If he wishes to adventure further he may then perform Lowsley's operation, perineal prostatectomy preceded by suprapubic drainage, and finally he may attempt perineal prostatectomy by Young's technic. Most men will stop at suprapubic prostatectomy, saving more lives with this and leaving the survivors in far better condition than after perineal prostatectomy, and doing one- or two-stage operations as their skill and experience dictate. But the accomplished urologist must be familiar with both technics.

To any one sufficiently inexpert to ask our advice, we must commend suprapubic prostatectomy because it is an easier operation to perform. It attacks at the point where the prostate obstructs urination and therefore if the surgeon succeeds in removing anything, he may hope to relieve retention, while if he approaches from the perineum, he must perform a perfect operation to get such a result.

There is still much confusion as to the merit of suprapubic drainage as a preliminary to suprapubic prostatectomy. The advantages of this procedure, the so-called "two-stage" prostatectomy, are the following:

1. Preliminary suprapubic drainage may be required because of the failure of urethral drainage.

2. It closes the fascial plains to infection and minimizes the prospect of perivesical abscess.[2]

3. The congestion of the prostate itself regresses more rapidly and completely under suprapubic than under urethral drainage so that prostatectomy after suprapubic drainage is followed by relatively less bleeding.

The disadvantages of preliminary suprapubic drainage, apart from the inconvenient lengthening of the patient's stay in hospital, relate chiefly to the relatively inexpert surgeon. The agglutination of the tissues around the wound will be such that when he comes to enucleate the prostate, he will inadvertently tear into the peritoneal cavity. Indeed, I have seen a young man valiantly attempting to enucleate the prostate through the vault of the bladder without realizing that he was in the peritoneal cavity, and curiously enough when I persuaded him to suture the peritoneal rent and remove the prostate by the more usual route, the patient kindly recovered without complications.

In as much as the patient's symptoms must be abated, signs stabilized and heart exercised between the time of suprapubic drainage and that of prostatectomy, this period will habitually cover at least two weeks and may be extended to three or more months. It is most noteworthy that those few desperate cases who have finally persuaded me to remove their prostates after many months of hesitation, have all survived the operation and been relieved by it. In contrast to them I recognize the loss of lives through haste.

It is my present practice to perform "two-stage" prostatectomy only upon patients that have to have suprapubic drainage because urethral drainage proves inadequate. This amounts to about half the cases. Yet I respect the opinion of those who perform preliminary cystotomy as the first step in all prostatectomies. My only quarrel with them is when they report the mortality following their operations as though the suprapubic drainage were innocuous, whereas in most clinics the mortality among prostatics during drainage is higher than after the subsequent prostatectomy.

Results of Prostatectomy.—The advocates of perineal prostatectomy report a slightly lower mortality. Only one suprapubic advocate has reported one hundred successive prostatectomies without a death, a record which has been exceeded by Young and one or two of his pupils. The average death rate from either procedure at the hands of most surgeons is between 5 and 10 per cent. Any good surgeon can perform a suprapubic prostatectomy if he has a urologist at his elbow to prepare the patient for operation. The perineal operation requires special skill. And as far as the patient is concerned the question is one of total mortality. Doubtless as many patients die during preparation as after operation. The total mortality of prostatism, even if we exclude those patients whose retention is but a terminal phase of some other

[2] At the moment of writing, I am greatly taken with prevesical section (incision and packing of the prevesical space without opening the bladder) as a routine preliminary to prostatectomy. The prevesical space is opened and the two vasa tied off at the moment the indwelling catheter is introduced. A delay of forty-eight hours is ample to seal the prevesical space from infection.

malady, is under the best of circumstances at least 10 per cent, and under unskilled care at least 25 per cent. In free city hospitals the patients arrive in so desperate a condition that the total mortality approaches 50 per cent.

The chief causes of death are sepsis, renal decompensation, cardiac decompensation, hemorrhage at the time of operation or within the two weeks following, embolism at any time up to the end of a month. The last is the only cause of death not strictly preventable. Besides these the patient has to fear the usual causes of death in the aged. Not only may he die of apoplexy or of cardiac decompensation during the months a feeble old man takes to convalesce from a capital operation, but in electing to operate the surgeon must reckon with the fact that the patient is in decline. Though he may triumphantly survive the operation he may never really regain his health and may die in a few months of intercurrent disease. The man who has had a high blood-pressure for years and whose pressure has fallen to 120 or lower is a particularly bad prospect from this point of view. Such patients are better off on the catheter, if acute complications can be avoided, for the few months they have to live.

And there is an invalidism which to many patients is worse than death. The incontinence of urine that follows perineal prostatectomy in the best of hands is one of these. Many cases reported "improved" after prostatectomy do not justify the term. If some residual urine persists, the frequency of urination is not relieved and the residual soon mounts to its former level. A contracted bladder, such as is illustrated in Figure 45, is a rare but utterly distressing complication. The patient empties his bladder, but he empties it every few minutes. Antispasmodic decompression, rest in bed and careful, gentle bladder irrigation often overcome this. If not, the source of irritation may be recognized in the vesicles and pericystitis and sometimes relieved by vesiculectomy.

The secondary pyelonephritis may lead to retention in the kidney pelvis and require nephrectomy. I have done postprostatectomy nephrectomy only three times and always successfully, the opposite kidney being in relatively good condition.

TRANSURETHRAL OPERATIONS

The mortality of prostatectomy used to be prohibitive. When I began to practice, the mortality upon private patients was about 30 per cent; mortality upon hospital patients at that period must have been well over 50 per cent. Hence, the many efforts to help the patient without endangering his life. Hence Bottini's galvano-incisor for the bladder neck, J. W. White's castration, Sir Reginald Harrison's vasotomy. Hence, also, the many operations which are now employed, each by its own inventor, to avoid doing a prostatectomy. Of the procedures that are employed at the present day, the non-operative ones, such as the deep x-ray treatment, have produced no results whatever when I have tried them. The operative ones, such as procedures of Young, Caulk, Braasch and Collings, will command serious attention when they prove their

worth by being adopted successfully by a large proportion of the profession. The difficulty with these transurethral attacks upon the prostate by various types of electrocauterization or by cutting instruments, is that they are of service chiefly in the attack upon the sclerotic bladder neck. Young admits this quite frankly; Caulk denies it and states that the advantage of his operation is that by removing part of a slightly enlarged prostatic lobe, he encourages the rest to subside. Braasch agrees with Young, so does Collings. In general, therefore, it is held that an attack upon a prostatic obstruction by a urethral instrument has no prospect of success if there is enlargement of the lateral lobes or if the median bar projects sufficiently to be described as a lobe.

The technic of preparing a patient for prostatectomy has reduced the mortality to a marvelous degree in cases of prostatic hyperplasia. The sclerotic prostates give an even better record. I do not remember to have lost a case of prostatic sclerosis after operation. Therefore, while deeply interested in the success of the urethral attack upon the sclerotic bladder neck or the "bar," I am inclined to urge my patients to submit to suprapubic operation which I believe will give them an average longer relief from retention than the attack through the urethra. It is to be remembered that the Bottini operation for prostatic enlargement and the Chetwood operation for bars and sclerosis have been given up because it was found that recontraction of the scar occurred from five to ten years following operation.

More than this may be alleged in favor of the suprapubic operation for sclerotic prostatism. Besides being an operation with inconsiderable mortality and a higher percentage and a longer duration of cure than has been proven for the urethral attack, it also has the advantage of permitting digital exploration of the prostatic urethra and removal therefrom of obstructing lobes that may have been overlooked in the course of cystoscopy or urethroscopy.

Recurrence of Prostatic Obstruction after Operation

It is an established tradition that slight prostatic enlargements and incomplete retentions are less amenable to operative attack than are the enormous prostates with established completed retention. The smaller the amount of tissue removed in the course of prostatectomy, the more likely it is that some portion of the gland will remain which, in future years, will enlarge. There has been much argument in other countries as to whether, after a complete prostatectomy, a recurrence of prostatic enlargement is possible. The question seems a little overrefined. To be sure, one does not remove the whole prostate and some of the gland remaining behind may unquestionably undergo hyperplasia, but patients from whom really large lobes have been removed do not have recurrence.

The types that recur are three:

1. Those upon whom an incomplete prostatectomy has been done and some of the hyperplastic tissue left behind.

2. Those in whom a sclerosis at the bladder neck has been overlooked, incompletely excised or actually provoked by tearing the mucosa away all around the urethral orifice as Freyer used to do.

3. Those who have the misfortune to be operated upon so early that the hyperplastic tendency is not fully developed and the remaining lobe or one part of a lobe will enlarge and obstruct in later years. I have only known this to occur three times.

I have, for example, operated upon a patient for prostatic retention and removed one lateral lobe. The opposite lateral lobe was entirely normal. He remained well for ten years, then returned with complete retention due to considerable enlargement of the lateral lobe which could not be removed at the time of the first operation.

Catheter Life

Patients by whom operation is refused or to whom operation seems unsuited may employ the catheter. Before this is agreed to cystoscopy should be performed so that one may be conversant with the conditions inside the bladder as to diverticulum and stone, as well as size and shape of the prostate itself.

The ancient rules as to the frequency with which the catheter should be passed are never followed by the patient. If the amount of residual urine is small and the bladder irritability slight the patient will refuse to pass his catheter more than once or twice a day. But as a rule he promptly goes into chronic complete retention and then should be urged to pass the catheter often enough to forestall incontinence. The traditional three times in the twenty-four hours are often not sufficient.

The patient might add many years to his life by being aseptic and gentle, but the average man cannot be bribed into either virtue by the promise of longevity. He totally neglects asepsis and uses his catheter like the ramrod of a gun. Some urethræ will withstand a marvelous amount of such rough treatment, but the majority will not and their owners die miserably.

The patient should be instructed always to keep the head of his penis clean and to wash his own hands well before touching the catheter. He should use a rubber catheter if possible, keeping a number of these in stock, so that they may be all boiled together and laid between the folds of a sterile towel, to be carried about and used when necessary, one by one. In order to catheterize himself, the patient washes his hands, takes his tube of sterile lubricant, anoints with it the end of his catheter, mops the lubricant from the catheter to the end of the penis holding the catheter at a point at least two inches from its extremity and never touching those terminal two inches. He passes the catheter slowly into the bladder up to the point where it just draws water, holds it there until the bladder is empty, then withdraws it. Once a day he irrigates his bladder with 1 : 4,000 solution of silver nitrate using for this purpose a douche bag and filling the bladder to the point of comfort two or three times. It is

preferable that the patient wash his bladder every day, for if any exception is made he will probably stop washing altogether.

Hexamethylenamin may keep the bladder clean better than the bladder wash. The patient who has to use a woven catheter certainly ought to be operated upon or else have a trained nurse constantly at hand to pass the catheter. Otherwise he will simply punch holes in his urethra and cause both himself and his physician untold trouble.

CHAPTER XXVI

URINARY CALCULUS: VARIETIES, ETIOLOGY, TREATMENT OTHER THAN RADICAL

A URINARY stone, or calculus, is a body resembling a stone in its general characteristics, and formed of crystalline urinary salts (exceptionally of other substances) held together by viscid organic matter, and showing, microscopically or to the naked eye, a laminated structure.

True calculi are composed of a nucleus, single or multiple, and layers more or less concentric of the same or of another material arranged around it (Figs. 80, 82, 83). This is the case for large as well as for microscopic calculi, even for those requiring a magnifying power of 250 diameters (Beale) to make out their lamination. This fact of lamination alone differentiates calculus from *gravel,* the latter being crystalline dust or concretions of crystals not showing definite structural arrangement.

The organic matter is usually quite overshadowed by the crystalline deposit. But exceptionally the organic matter (blood-clot or fibrin) predominates. The stone still shows laminæ, and salts (usually calcium phosphate), but has the consistency of soft rubber or of half-dried mud. Such stones, called fibrinous, colloid or blood calculi, are intermediary in type between the familiar hard calculus and the unorganized masses of crystals and fibrin sometimes found.

The *nucleus* of a stone may consist of whatever, among the organized, crystalline, or earthy constituents of normal or pathological urine, is capable of concentrating into a more or less solid mass; or it may be a foreign substance either coming from within the body or introduced from without. The nucleus is usually in the center of the stone (Figs. 80, 82). An unusual eccentric development is shown in Figure 83.

The calculus takes its distinguishing title from the salt or salts which enter chiefly into its composition.

VARIETIES

The more refined and obscure points relative to the varieties of stone and their pathogenesis cannot be dwelt upon here. My father considered the subject at length in another place.[1] All stones come under one of the following groups:

Primary stone, which develops in an acid urine without any antecedent inflammation, may consist of uric acid, urate of soda, lime, or potassium, oxalate of lime, cystin, xanthin, carbonate of lime, crystalline phosphate of lime, or indigo.

[1] *International Encyclopaedia of Surgery* (Ashhurst), Vol. VI, p. 145.

Secondary stone, which develops in an alkaline urine as the result of inflammation, may consist of ammoniomagnesium phosphate (triple phosphate), amorphous phosphate of lime, tricalcic phosphate, urate of ammonia, or urostealith.

Among the primary stones only those composed of uric acid, oxalate of lime, and urates are common; the other varieties are extremely rare. Secondary stones are commonly formed of mixed phosphates. Secondary phosphatic stones are often formed about a primary stone as a nucleus.

FIG. 80.—URIC ACID CALCULUS (SECTION).

The marked central lamination suggests a preponderance of uric acid, while the more amorphous periphery shows an intermixture here of urates.

The *color* of stone is that of its crystals modified by blood pigment. Thus the smooth mucus-covered phosphatic stone remains white, but the rough oxalate stone usually becomes brownish.

The *form* of a stone depends upon various circumstances, as illustrated herewith. If fixed, it takes the shape of the cavity in which it lies. If movable, it is ovoidal. If in contact with another stone it is faceted. Numerous small stones lying in contact are faceted or spheroidal.

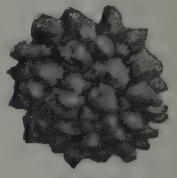

FIG. 81.—OXALATE (MULBERRY) CALCULUS.

Uric Acid.—Uric acid is found in 80 per cent of all stones (Morris). It is usually mixed intimately or in layers with urates and oxalate of lime. Its color varies from a light fawn to a dark brown, in proportion to the admixture of blood and oxalates. When cut and polished it resembles an agate, displaying a concentric arrangement of irregularly curved lines of slightly varying color and thickness (Fig. 80). This type of stone is common in the bladder, rare in the kidney and ureter.

Oxalate.—Oxalate of lime stone is commonly single, blackish-brown in color, and very hard. It is usually covered with blunted asperities, whence it has acquired the name of mulberry calculus (Fig. 81). Upon section it shows undulating laminæ, which may vary widely in color, as there is often an admixture of uric acid (Fig. 81).

Phosphate.—Mixed phosphate calculus is the common *secondary* calculus. It may grow to an enormous size, and may be single or multiple (Figs. 82 to 86). It forms around a primary calculus, a blood-clot, or a foreign body. It is granular, soft, light in weight, and of a dirty white color. It may be amorphous or laminated.

The other forms of calculi are so rare as to require no special mention. Cystinuria has a medical rather than a surgical interest. Xanthin[2] is even rarer. I have removed one cystin and one xanthin calculus.

[2] *N. York M. J.,* Jan. 16, 1915, p. 120.

ETIOLOGY

The etiology of primary calculus is obscure. The negro is said to be singularly exempt. There are two periods of life during which they are most frequently found—viz., from birth to the tenth and again from the twenty-fifth to the fifty-fifth years. But the most notable feature of the occurrence of primary stone is its great frequency in certain localities and its comparative rarity in others. Thus India leads the list with hundreds of operations a year. Egypt perhaps, comes second, and North America is, as a whole, comparatively exempt. Yet in certain parts of India primary calculus is quite as rare as it is with us, and it has also been observed that the tendency to stone among the inhabitants of a certain district seems to increase or decrease regularly over a long period of years. To explain these vagaries various theories have been adduced. The influence of the climate, the soil, the water, the civilization of the inhabitants, as affecting their occupations, the diet, especially the amount of salt habitually taken—all of these and various other factors have been implicated.

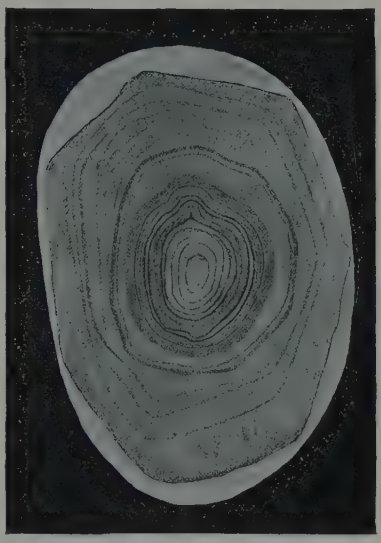

FIG. 82.—SECTION OF CALCULUS OF MIXED URIC ACID AND OXALATE OF LIME, COATED WITH PHOSPHATES.

Such a stone would pass for phosphatic on inspection.

There is some evidence of a hereditary tendency to stone formation closely allied to the uric acid diathesis. Indeed, the predisposing cause of primary stone is undoubtedly the presence of crystals in the urine. Without crystals in there can be no calculus, yet the urine may contain crystals for years and no stone form. A notable example is the phosphaturia so common in the young. It may continue for years, and the urine may be so thick with phosphates that the terminal drops, if they fall upon the patient's shoe, give the effect of a splash of mortar. Yet phosphatic stone is never due to this phosphaturia. In point of fact, the microscope reveals that a urinary calculus is made up, not of the sharp-pointed crystals so commonly seen in the urine, but of rounded masses, showing neither angles nor polarity, and consisting of an amorphous collection of granules of a urinary salt embedded in a structureless, albuminous substance. If true crystals appear, they occur simply as foreign bodies entrapped in the stone. Rainey and Ord have conclusively shown that the determining cause of calculus is the increased density of the urine and the presence of colloid substances in solution, in conjunction with an excess of urinary salts; for "a crystalloid is deposited from solution in the presence of a colloid," and crystals introduced into a colloidal

solution are disintegrated and reformed by simple, molecular coalescence.[3] Thus the nucleus of a stone is always laid down in an albuminous substance. A blood-clot, a foreign body surrounded by pus, or the mucoid exudate of a mild infection may form this nucleus. And once the nucleus has formed, it is always in such a foreign body surrounded by albuminous matter that new layers of stone are constantly being formed.

The etiology of secondary phosphatic stone is infection with cocci that split urea into ammonia and carbon dioxid. The ammonia alkalinizes the urine and makes the pus ropy. The phosphates thrown down in the alkaline urine deposit amid the albuminous mass of gummy pus and a rapidly growing phosphatic stone is thus formed.

Fig. 83.—Phosphatic Calculus.

Relatively rapid growth results in eccentric development.

The deposit of adherent phosphates upon an ulcer, simple, tuberculous or neoplastic, is due to the same process.

Yet it seems as though some bacteria had the faculty of inciting phosphatic deposit more than others. Various efforts to identify these organisms have been made. Thus Shaw and Hill[4] identified in incrusted bladder wounds a Gram-positive bacillus resembling the diphtheria bacillus and occurring in the form of short, plump, ovoidal or cocciform rods, which grow on Löffler's blood-serum as long unevenly staining rods, resembling the *Corynebacterium diphtheriæ*. It reproduced incrusted lesions in animals on condition that the wound was kept bathed in urine. The name *Corynebacterium thompsoni* was given to this organism.

Hager and Magath[5] obtained from their cases of incrusted cystitis a mixed growth of streptococci, staphylococci and colon bacilli and a Gram-negative bacillus which they first named the *Salmonella ammoniæ* because of its power to crack urea. Hager later preferred to call the bacillus *Proteus ammoniæ*. Other phosphatogenic bacteria have been described.

The rate of growth of a stone must vary greatly. Thus it is known that phosphatic stones grow, as a rule, much faster than primary ones, and yet my father removed a uric acid calculus weighing 2 ounces from a boy nine years old, and a hairpin from a girl's bladder in which it had remained for more than a year, which was incrusted with less than a dram of phosphates.

But the practical problem in the etiology of stone is not "Why does stone form?" but "Why is stone retained?" If every stone were passed as soon as it is formed, renal colics would be even more common than they are; but renal cal-

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[3] Schade, *München. med. Wchnschr.*, Apr. 4, 1911.
[4] *J. Urol.*, 1925, xii, 689.
[5] *J. Am. M. Ass.*, 1925, lxxxv, 1352.

culus would not be a surgical disease. The formation of stone we can do little to prevent. The retention of stone is in large part under our control.

PREVENTIVE AND SOLVENT TREATMENT OF CALCULUS

In as much as the discovery or passage of a single stone suggests the possibility that others may be present or may subsequently form, every case of urinary calculus presents the problem of how to prevent the recurrence of stone, while many patients, moved by the blazon of the Buffalo lithia bottle, inquire, "How shall I dissolve my stone?"

Let us dismiss the Buffalo lithia claim at once. The only special virtue that can be claimed as proven for this or any other water is that by diluting the urine it discourages the deposition of crystals and the formation of stone, and further that it encourages the spontaneous fracture of uric acid stone. But this fracture of stone does not better matters. Quite the contrary. Some of the small fragments escape but most of them are retained and grow as numerous stones where there was previously but one.

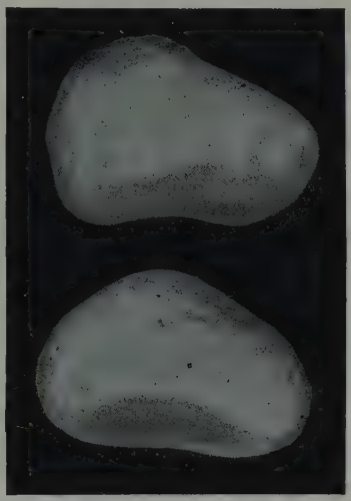

Fig. 84.—Multiple Phosphatic Calculi. (Natural size)
The irregular shape is due to friction. (There were six similar stones in this case.)

An actual solution of stone has been accomplished by Crowell,[6] who has dissolved a cystin kidney stone by the administration of large doses of bicarbonate of soda.

Incrusted ulcers can be rid of their adherent phosphates by various means. I have relieved one obstinate case by administration of hexylresorcinol, others by the injection of argyrol into the bladder, others by knocking small masses of crystals off the ulcers with the high frequency spark and the subsequent treatment of cystitis with bladder irrigations of silver nitrate of cauterization of the ulcers with 20 per cent silver nitrate through the straight urethroscopic tube.

Incrustation of bladder wounds can be controlled by early administration of hexylresorcinol, if the patient can submit to the necessary concentration of the urine without undue damage to the renal function. Shaw healed incrusted wounds by application every three hours of 5 per cent acetic acid. Caulk healed incrusted ulcers by the injection into the bladder or the kidney pelvis of a paste of *Bacillus bulgaricus* tablets in a little water. This is an uncertain remedy. Hager was not able to cure many of his cases with it, nor was I. Acidification of the urine does no good. For obstinate bladder cases the ultimate treatment is suprapubic section, curettage of the ulcers and touching them with 50 per

[6] *J. Urol.*, 1924, xi, 545.

cent solution of silver nitrate, followed by daily irrigations with weaker solutions of the same.

But medical aids must be invoked to prevent recurrence of stone after all calculi have been passed or removed.

The treatment includes:

1. Relief of retention
2. Dietetics—exercise—encouraging elimination by other avenues
3. Diluting the urine
4. Specifics

1. **Relief of Retention.**—In the past our attention has been centered upon more or less futile attempts to prevent the formation of stone. The future will see more attention paid to attempts to prevent the retention of stone. For, as stated above, stone formation is of small importance as compared with stone

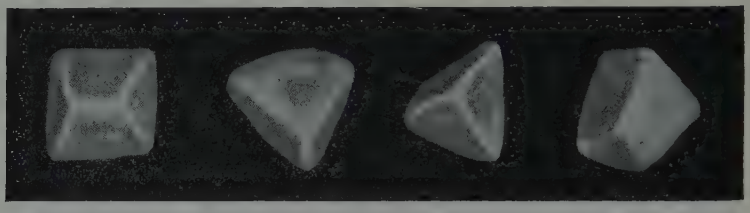

FIG. 85.—MULTIPLE SMALL PHOSPHATIC CALCULI. (Natural size)
These stones are selected from a group of thirty-three similar ones. These small stones show sharp faceting from friction.

retention, especially by slight ureteral or prostatic obstructions. No diet, medicine or mode of life is guaranteed to prevent the re-formation of stone. But good surgery may often guarantee the prompt passage of any stone that does re-form, and may thus solve the problem of the patient's cure.

The details of the relief of retention are dealt with specifically for each type of stone.

2. **Hygiene.**—Hygiene and mode of life have nothing to do with the cure of phosphatic stone, since this is secondary to infection, nor with the amorphous urate stone for this will inevitably recur in the bladder unless relief is afforded to the retention. Hygiene relates only to oxalate stones.

The two great stone-forming periods for oxalates are intra-uterine life, and perhaps early infancy, and the years between thirty and fifty. Why oxalate stones should prefer these periods is not quite clear. They might perhaps be called sedentary, though mothers and golfers would deny that. The two factors of the greatest importance are, on the one hand, an excessive nitrogenous intake, and on the other hand, an excretory sluggishness, perhaps an actual retention of urine.

The fetus we cannot reach. But the middle-aged patient begins to have renal colic during the time when he is exchanging tennis for golf or giving up

exercise altogether, really settling down to the hard struggle of self-support, or the even sterner struggle for success, is likely to smoke too much, to drink too much whisky and too little water, to overeat, to be mildly constipated, perhaps to show indican and a high blood-pressure. Such a man requires exercise. Exercise is the use of the muscles in the open air, in an enjoyable fashion, so violently as to cause perspiration. His diet should be low in nitrogen; alcohol, tea, coffee and tobacco should be used sparingly, and his bowels should be kept freely open.

3. **Dilution.**—The difficulty with all the above restrictions is that they are not for three months, but for twenty years. Unless they are prescribed with a

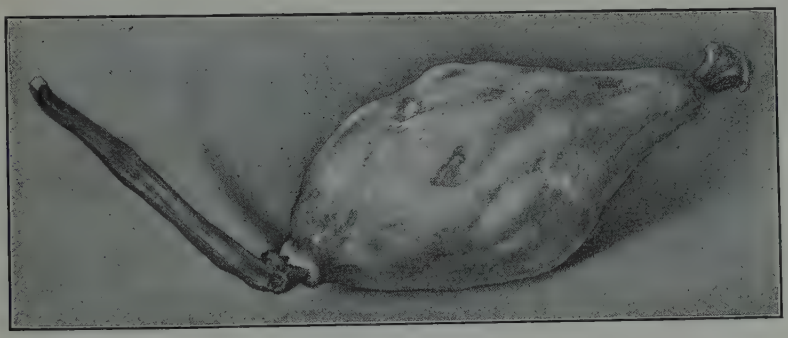

FIG. 86.—PHOSPHATIC CALCULUS.
Found upon a twig lost in the bladder during urethral self-abuse.

very clear understanding of the patient's personality they are futile. On the other hand, the patient is usually quite willing to return twice a year for urinalysis. Advantage may be taken of this to insist that he drink enough water to keep the specific gravity of the urine down to or below 1.015. So long as this is done the likelihood of stone formation is relatively slight. Patients who have difficulty in keeping the urine thus diluted will be much assisted by an occasional course at a diuretic or cathartic mineral spring. The English, than whom one could not ask for better authority upon such a subject, show a strong preference for Contrexeville and Carlsbad. French Lick in Indiana is of benefit to many persons.

4. **Specifics.**—Specifics for stone appeal so little to the modern mind that it seems scarcely worth while to enumerate them. Casper [7] advocates the use of glycerin in tablespoonful doses, both to prevent the formation of calculi, and to favor their passage.

[7] *Med. Klin.*, October 6, 1915, ciii, 1611.

CHAPTER XXVII

RENAL AND URETERAL CALCULUS

Calculi occupying the kidney pelvis or calices are spoken of as renal; those occupying the ureter are called ureteral calculi. All ureteral calculi are actually renal calculi that have slipped down from the pelvis of the kidney and caught in the ureter. Probaby all primary vesical calculi originate in the kidney.

Renal calculi are usually single. Exceptionally a great number of stones are found. Thus Morris removed two hundred stones from one kidney and Dessirier and Legrand found four hundred calculi in the left kidney and sixty in the right at the autopsy of a young soldier who during life had shown no symptoms referable to the kidneys. Renal calculi run up to about 100 grams (3 ounces)[1] in weight, the large stones being irregularly branched to fit into the distorted and dilated pelvis and calices (Figs. 28, 31, 32, 87, 88). In operating upon a suppurating or tuberculous kidney one occasionally meets with very small stones, scarcely more than phosphatic grit. Fibrinous calculi are also sometimes encountered.

Kraft found renal calculi forty times in 2,953 autopsies; both kidneys were affected fifteen times. Legueu and Albarran agree that in about half the cases both kidneys contain calculi, yet recent x-ray investigations go to show that in the living the proportion of bilateral cases is not so great.

Ureteral calculi are ovoidal in shape. If multiple and in contact they are faceted, but they are almost always elongated in one diameter and therefore *do not throw a round shadow* under the Roentgen ray, a fact of great importance in the study of such shadows (Figs. 29, 30; also Plate XIII).

Ureteral stones are usually unilateral, single, ovoidal, small. Most exceptional are such stones as those removed by Fedoroff, length 19 cm., weight 52 grams; Bloch, length 13 cm., weight 54 grams; and Jacobs, length 7:5 cm., weight 44 grams.

The relative frequency of renal and ureteral calculi is still a question for dispute. In the preradiographic period the preponderance of renal over ureteral calculi was notable. To-day the radiographer finds most calculi in the ureter. Thus Leonard[2] found calculi thirty-six times in the renal pelvis against seventy times in the ureter.

The x-ray catches the stone in transit, as it were, for all renal and ureteral stones originate in the renal pelvis, and of those seen by the radiographer in the

[1] Watson and Cunningham depict a calculus that weighed 1½ pounds.

[2] *J. Am. M. Ass.*, 1907, xlix, 1094; *ibid.*, 1909, lii, 289.

ureter the greater number—thirty-one out of Leonard's forty-six cases—are passed spontaneously.

The points in the ureter where a calculus is most likely to be caught are (percentages given by Jeanbrau [3]):

1. One or two cm. below the renal pelvis, 16 per cent.

2. At the lower end of the ureter, within its ultimate 10 cm., 51 per cent; less often in its course through the bladder wall, 17 per cent.

3. At or about the pelvic brim, 15 per cent.

PATHOLOGY

The changes that occur in the kidneys and ureters from the presence of calculi may be considered under three heads—viz., retention, ulceration, and inflammation.

Retention.—A calculus formed in the renal pelvis may at any moment slip down and be caught at the orifice of the ureter, or at any physiological or pathological narrowing in that duct. Such an impaction may be partial or complete. It is usually partial, and as the urine dammed up behind this sudden obstacle brings pressure upon it, the stone is forcibly driven into the ureter, setting up a *renal colic*. This is relieved by the passage of the stone into the bladder, by its slipping back into the pelvis, or by the gradual accommodation of the parts to the new conditions. If the stone remains impacted it causes either partial retention resulting in *hydronephrosis,* or complete retention resulting in an acute anuria and subsequent atrophy of the kidney, unless the obstruction is relieved. This complete retention is evinced by *anuria*—calculous anuria it is called—which is partial or temporary if the opposite kidney is able to continue its functions, permanent and fatal if the opposite kidney stops secreting, whether on account of reflex congestion or of bilateral calculous obstruction.

Ulceration.—Ulceration occurs at whatever point in the calix, the pelvis, or the ureter a stone may rest. If the stone is small and movable the ulcercation may be insignificant. If it is large or impacted, the ulceration may be so deep and extensive that actual *perforation* occurs, permitting the stone to escape from the kidney, the pelvis or the ureter, into the surrounding tissues. This complication, associated as it is with urinary extravasation, is as unusual as it is grave. *Ureteral stricture* results from calculous impaction.

Inflammation.—It is futile to attempt to enumerate the various lesions that may be caused by one or more stones in the various portions of the upper urinary tract. The lesions of retention, ulceration, and inflammation are combined in endless variety. There may be only localized suppuration about a small calix calculus, or there may be numerous calculous pockets throughout the kidney; the entire organ may be reduced to a multilocular abscess cavity filled by a great branching stone (Plate XI). The kidney may be found atrophied, and closely contracted around a stone that had caused complete

[3] *Trans. French Urol. Ass.*, 1909, xiii.

obstruction years before (Plate XII). Pyonephrosis results from obstructions of the ureter by stone or stricture when there is infection. Suppuration within the organ may be associated with *perinephritis* from extension of the inflammation or from rupture of the sac. The ureter shows various degrees of dilatation, ureteritis and periureteritis. The longer the disease continues the more extensive the destruction of renal tissue and the greater likelihood of bilateral calculous disease.

The Ureter.—The relations of stone and ureter are four, viz:

1. The stone is simply in transit. It may catch from time to time, causing renal colic and perhaps slight temporary ureteritis and dilatation; but ultimately passes and leaves no permanent change in the canal.

2. The stone is definitely arrested. The ureter above it is dilated, about it ulcerated, below it strictured. The stone may be relatively movable, at operation, or fixed. As it grows it may become encysted in a pocket in the ureter wall.

3. The ureter ruptures by (*a*) acute gangrene, or (*b*) ulceration about an encysted stone. The result is usually acute retroperitoneal phlegmon, infiltration of urine, abscess, fistula. Rarely an encysted stone escapes silently into the retroperitoneal tissue.[4]

4. The ureter is so dilated, the stone so smooth and small, that the latter slips readily to and from the pelvis, up and down the ureter.

Carcinoma.—I have seen two cases of renal carcinoma, apparently secondary to stone. Coryell [5] reports nine such cases.

Tuberculosis.—Plate XI illustrates an ancient calculous pyonephrosis secondarily invaded by tuberculosis. The opposite condition, viz., phosphate deposits in a primarily tuberculous kidney, is the common one.

SYMPTOMS

Renal calculus may exist for years without causing any symptoms whatever. Morris mentions the notable symptoms caused by renal calculus in 103 cases of his own. These he tabulates as follows:

Pain occurred in	71 cases	(69 per cent)
Pyuria occurred in	50 cases	(48 per cent)
Renal colic occurred in	44 cases	(43 per cent)
Hematuria occurred in	41 cases	(40 per cent)
Kidney palpably enlarged in	27 cases	(26 per cent)
Troubles of micturition occurred in	24 cases	(23 per cent)

Pain.—Of calculous diseases, Morris writes: "They are the most frequent and most painful of surgical diseases of the kidney. Probably no disease, except acute tetanus, is capable of causing worse suffering." The various pains due to renal and ureteral calculi are renal colic, pressure pains, and reflex pains.

[4] *Cf.* Frenkel, *Guyon's Annales,* xxix, p. 1825.
[5] *Bull. J. Hopkins Hosp.,* April, 1915, xxvi, 93.

PLATE XI.—"SILENT" BRANCHING PHOSPHATIC CALCULUS.

The kidney pyonephrotic. Pyuria the only symptom. Acid-fast bacilli. The tuberculous lesion was a secondary small ulcer (not shown).

PLATE XII.—CALCULOUS PYONEPHROSIS.

Nephrectomy because of secondary abscess. History of more than forty years' duration. The kidney has become a fibrolipomatous mass. Abscess at upper pole (its dimensions suggested).

Renal Colic.—This is the most characteristic symptom of stone in the kidney. It is due to the impaction of a stone in the ureter. The pain is paroxysmal in character. It commences suddenly in the loin or side, at any time, when the patient is seemingly in the best of health. It shoots down the ureter into the scrotum and to the end of the penis. The testicle of the affected side is often strongly retracted. Indeed, the entire scrotum and penis may be drawn up into a hard knot, as it were. The pain may also extend down the thigh on the affected side. There may be an incessant desire to pass water. What little urine is voided comes away high-colored and tinged with blood. If the paroxysm is severe, faintness, nausea, and vomiting occur, the skin is covered with a cold sweat, and the patient passes into severe shock.

In the intervals between paroxysms there is a sense of soreness and discomfort perhaps amounting to continued pain, or the relief may be absolute. After one or more paroxysms, lasting from a few hours to many days, all pain suddenly ceases. This sudden cessation indicates that the stone has been liberated. It may have fallen back into the pelvis of the kidney, have passed down into the bladder, or have reached some dilated portion of the ureter, where it rests without interrupting the urinary outflow.

If the impaction has occurred at the upper end of the ureter and is relieved by the stone slipping back into the pelvis, the pain during the attack is usually most intense in the loin and radiates across the back rather than down the ureter. On the other hand, if the stone travels down the ureter to the bladder, its descent is often marked by a progression of the pain from the loin to the pelvis—interrupted by periods of relative or absolute ease—with a corresponding increase in the vesical irritability and the pain and retraction of the testicle. But this relation of the pain to the progress of the stone has many exceptions. Thus bladder irritation may result from stone in the kidney pelvis, renal colic from sclerosis of the prostate.

Pressure Pains.—When the stone is in such a position or of such a size as to fill the cavity in which it lies, it may cause a dull continuous ache associated with tenderness. This ache is rarely severe; indeed, some persons will endure it for years without attaching any great importance to it. It is usually felt over the kidney pelvis, opposite the umbilicus, at the outer edge of the rectus.

Reflex Pains.—The two most notable renal reflex pains excited by stone are: (1) Pain following the course of the ureter into the pelvis and thence radiating to the testicle and thigh, and (2) painful and frequent urination.

I have twice seen frequent and painful urination as the only symptom of a stone filling the renal pelvis. But this symptom usually means stone at the lower end of the ureter.

The pain may occasionally be felt only in the "stomach" and associated with vomiting. Or it may be "sacro-iliac" or "lumbago" in type.

It is questionable whether stone in one kidney may give pain referred only to the opposite organ. This so-called "renorenal reflex" is usually due to disease of the opposite kidney.

Hematuria.—As shown by the table, considerable hematuria is a fairly constant symptom of stone. Yet it is variable to the last degree. Some hematuria usually accompanies and follows a renal colic, and in most cases there is a fairly constant oozing of blood, showing itself only by the presence of a few red cells and a trace of albumin in the urine. Blood casts and long ureteral clots rarely occur. The bleeding is usually made worse by exercise, though the pain is not, and hence the presence of a great number of red cells in the sediment centrifuged from the urine passed after exercise is suggestive of stone. But, after all, the hemorrhage caused by renal stone is an inconstant symptom. It may be entirely absent even after a renal colic.

The symptoms of pyelonephritis or pyonephrosis appear with the onset of infection.

COURSE OF THE DISEASE

The course of the disease is entirely irregular. The character of the symptoms bears no precise relation to the size or position of the stone; and the progress of the disease varies from the cases that have only a single fatal attack of calculous anuria or that die of some intercurrent disease without ever having manifested any symptom referable to the calculi with which their kidneys are filled to those that drag on for years with chronic renal suppuration and repeated passage of stone.

Several types of the disease may be mentioned, due allowance being made for the fact that a given case is often a compound of several types. The surgeon encounters: (1) Cases without symptoms, (2) cases of renal colic, (3) cases of calculous anuria, (4) cases of renal distention, and (5) cases of renal suppuration.

Cases without Symptoms.—The onset of symptoms of renal calculus is not the beginning of stone. When the minute calculus first forms in the renal pelvis its place is determined by the shape and drainage of that cavity. If the pelvis is well drained the urinary stream will sweep the little calculus into the ureter before it has attained any great size. It announces its passage to the bladder by a series of renal colics, even though it be extremely minute, no larger than a grain of wheat. But if it is a smooth urate stone, it may pass down the ureter without exciting any symptoms.

But if the pelvis is not well drained a stone naturally sinks into some calix where it slowly and silently grows. At most it causes a pyuria, or a microscopic hematuria. But since this excites no subjective symptoms it is usually entirely overlooked. Such stone, if actually silent, may be discovered only at autopsy or by the investigation that follows the disclosure of albumin and pus in the urine as the result of an examination for life insurance. Such stones frequently grow quite silently until the kidney is almost totally destroyed and the x-ray shows an enormous stone (Plate XI). Although it is possible for stone, even bilateral renal stone, to remain thus silent for twenty or thirty

years or longer, at the onset, or at least during the first five or ten years of the disease, small pieces of stone are likely to descend into the bladder, giving a history either of renal colic or of vesical calculus. Later in the disease the stone may cause slight, painless, protracted hematuria. It is very likely to cause some disturbance of urination, and perhaps excite a great deal of bladder irritability, and when large it always causes pyuria, albuminuria and diminution of the kidney function. If all of these symptoms are either overlooked or misinterpreted the patient may be left to die of renal insufficiency alone or excited by some intercurrent disease or accident.

Renal Colic.—The general character of renal colic has been described. The colics usually recur for no more than three or four months if the stone is to pass. Yet even when the stone has passed, the stone-forming habit is likely to continue, so that either from the discharge of calculi collected in the kidney pelves above, or from the actual formation of new stones, the patient who has once had renal colics is rather likely to have further attacks in later years. In one sense, however, renal colic with the passage of stone, and no evidence of any deterioration of kidney function or accumulation of stone left behind in the kidney pelvis, is a good omen, for it means that the kidney pelvis drains well, and that if subsequent stones do form they are likely to be passed as was the first one.

Reflex Symptoms.—Other cases again give only reflex symptoms. One of my earliest professional recollections is of an old man who for years suffered only from painful and frequent urination. His bladder was washed, searched, sounded, and even cut—all to no avail. New York's best surgeons of those days could do nothing for him. Finally, his protracted agony was terminated by a fatal attack of suppression of urine, as it was called. Autopsy revealed a normal bladder and one kidney atrophied and tightly contracted about a calculus, the other somewhat dilated and with a stone plugging the ureteral orifice. Yet he had never complained of a symptom referable to either kidney. His local symptoms had been entirely vesical.

Calculous Anuria.—Calculous anuria is a stoppage of the urinary flow caused by the plugging of one or both ureters with calculi. It is part suppression, part retention. The terminal anuria in the case mentioned above was a pure retention. One kidney had been out of commission for years; the flow of urine from the other was stopped by the obstructing stone. In other cases the blockage of one ureter throws such a burden of excretion upon the opposite kidney that it becomes acutely congested, and suppression ensues. Thus anuria may ensue (1) when both ureters are completely obstructed, or (2) when one ureter is obstructed and the opposite kidney absent, hypertrophied, or sufficiently diseased to be incapable of enduring the congestion forced upon it. The acute obstruction is clinically unilateral, but unless both kidneys are diseased anuria does not occur.

Pathology.—The pathology of calculous anuria is striking and characteristic. The obstructed kidney, which may be hydronephrotic or suppurating, is in-

tensely congested. It is enlarged to twice or thrice its normal size and is dark in color. On section its tissues are found friable and edematous. Such a large, soft purple organ once seen is never forgotten (Fig. 87).

Symptoms.—The symptoms of calculous anuria may be divided into three stages: (1) The premonitory stage. (2) The tolerant stage. (3) The uremic stage.

1. In the *premonitory stage* there is usually more or less pain, perhaps an actual colic, referred to the kidney. It persists from a few hours to a few days. But there may be no premonitory pain whatever.

2. The *tolerant stage* is characterized by but one symptom—viz., anuria. The patient does not pass water. This anuria is rarely absolute. A few drams

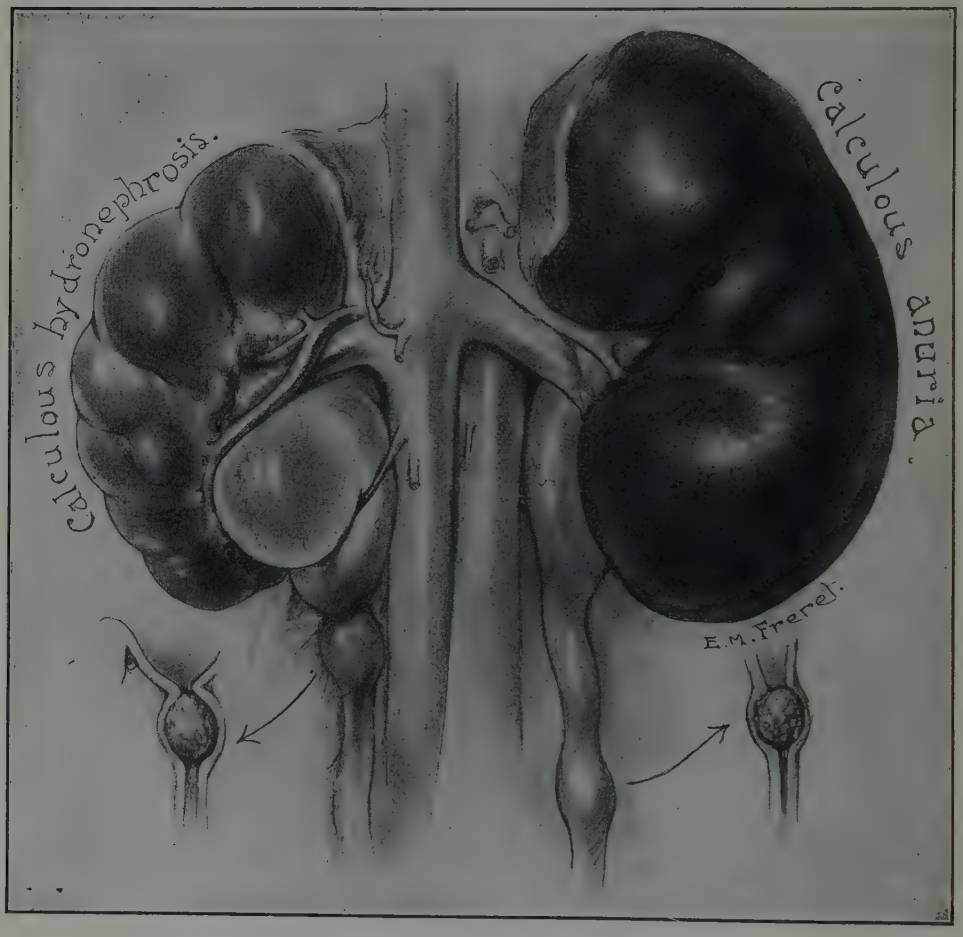

FIG. 87.—CALCULOUS ANURIA.

The right kidney hydronephrotic, due to chronic partial ureteral obstruction (secondary kinking over a vessel). The left kidney in compensatory hypertrophy, suddenly and completely obstructed. The right kidney ceases to function by reflex action.

of urine tinged with blood are passed every day, or perhaps the anuria runs a remittent course. At one time or another 2 or 3 liters of urine may gush forth, a misleading promise of relief, for the flow is but temporary. This state of affairs lasts from three days to a week. *Not a drop of urine may be passed during several days and yet the patient may, apparently, remain in the best of health.* No more striking contrast could well be imagined than that presented by calculous anuria: on the one hand, the grave renal lesion, the absolute retention, the swift fulminating character of the uremic period soon to follow; and, on the other hand, this entire absence of symptoms, local or general. The patient goes about well content. He eats, sleeps, and works pretty much as usual. Whatever pain he has had in the loin is past, and his present discomforts are insignificant. Yet all the while there is brewing within him a crisis swift and terrible.

Spontaneous recovery may occur. The obstruction is relieved; the urine gushes out, 3 or 4 liters a day, and all is well. This may occur in 20.8 per cent (Morris) to 28.5 per cent (Legueu) of cases. In Legueu's[6] cases the spontaneous cure took place on the third day once, between the fifth and the tenth day twice; later still in five instances. Yet it is obvious that one should not await spontaneous cure.

When spontaneous recovery does not occur the patient passes into the third stage of the disease at the end of a week or ten days.

3. The *uremic stage* is usually ushered in by hiccough or vomiting. This is the first warning. It may continue for a day or two without additional symptoms. The pulse is tense, the temperature usually subnormal. Constipation becomes absolute and the intestines are distended with gas. The vomiting grows more severe, the intellect becomes dulled and stuporous. The patient's mind may wander a little, and he may even have maniacal attacks. Thus he sinks away and dies, usually within two or three days of the first hiccough or vomiting.

Such is the clinical picture of the gravest and most fatal of the many serious complications of urinary lithiasis. Of course there are atypical cases: the obstruction may be intermittent or partial; but such cases require no special notice.

Calculous Hydronephrosis.—Calculous hydronephrosis is due to the impaction of a stone in the ureter (Fig. 30), or rarely to a stricture secondary to calculous ulceration. The development of the hydronephrosis is habitually marked by a series of renal colics, and hydronephrosis may be one of the features of calculous anuria. The symptoms and signs of hydronephrosis are detailed elsewhere.

Renal Suppuration.—Stone in the kidney is one of the most common causes of pyelonephritis. It also causes pyonephrosis (Fig. 89); while secondary phosphatic calculus or phosphatic deposit upon a preëxisting calculus results from the inflammation.

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[6] *Guyon's Annales*, 1895, xiii, 865.

The variations imprinted upon the classical picture of pyelonephritis and pyonephrosis by the presence of stone are few. There are the same urinary septicemia, the same local symptoms. There may be colic. Hemorrhages occur from time to time. The inflammation is rarely acute or virulent, but progresses slowly, terminating finally in pyonephrosis or perinephritic abscess.

DIAGNOSIS

The accurate diagnosis of stone in the kidney pelvis or the ureter must cover the following points:

1. The presence or absence of stone
2. The number, position, and distribution of stones
3. The presence or absence of renal infection
4. The functional capacity of both kidneys

In order to make this diagnosis, familiarity with urography and with the methods of testing the renal function is essential. Without the x-ray and the ureter catheter it is possible, in certain cases, to diagnose the presence of stone with some accuracy and to operate for its relief with some success; but both methods are necessary in order to insure good work in all cases, and in order to insure any diagnosis at all in some.

The most typical history of renal stone, even if accompanied by characteristic gross evidences of such conditions as pyonephrosis or calculous anuria, is not enough to indicate to the surgeon such important facts as the position and number of the stones present, or the functional capacity of the opposite kidney; and most cases first apply for relief at a time when the history is anything but characteristic, the physical signs anything but adequate to insure appropriate treatment.

The following table, which has been prepared by Charles Eastmond as a result of his radiographic experiences, indicates quite accurately how often the symptoms and physical signs are misleading as to the presence or absence of stone. They are still more often misleading as to the condition of the kidneys.

TOTAL CASES, 80 { Calculus present ....23 = (28.75%)
Negative .....57 = (71.25%)

23 cases of calculi {
- With typical symptoms (renal) 8
  Two had additional calculi in opposite kidney.
- With indefinite symptoms 9
- With symptoms on opposite side to calculus 3
- With symptoms referred to other parts 3
  Of these, two had renal symptoms with calculi in the bladder; one vesical symptoms with calculus in kidney.

58 with typical symptoms { calculi .....14 = (24.14%)
calculi in suspected region ..... 8 = (13.79%)

22 with indefinite symptoms—calculi ..... 9 = (40.90%)

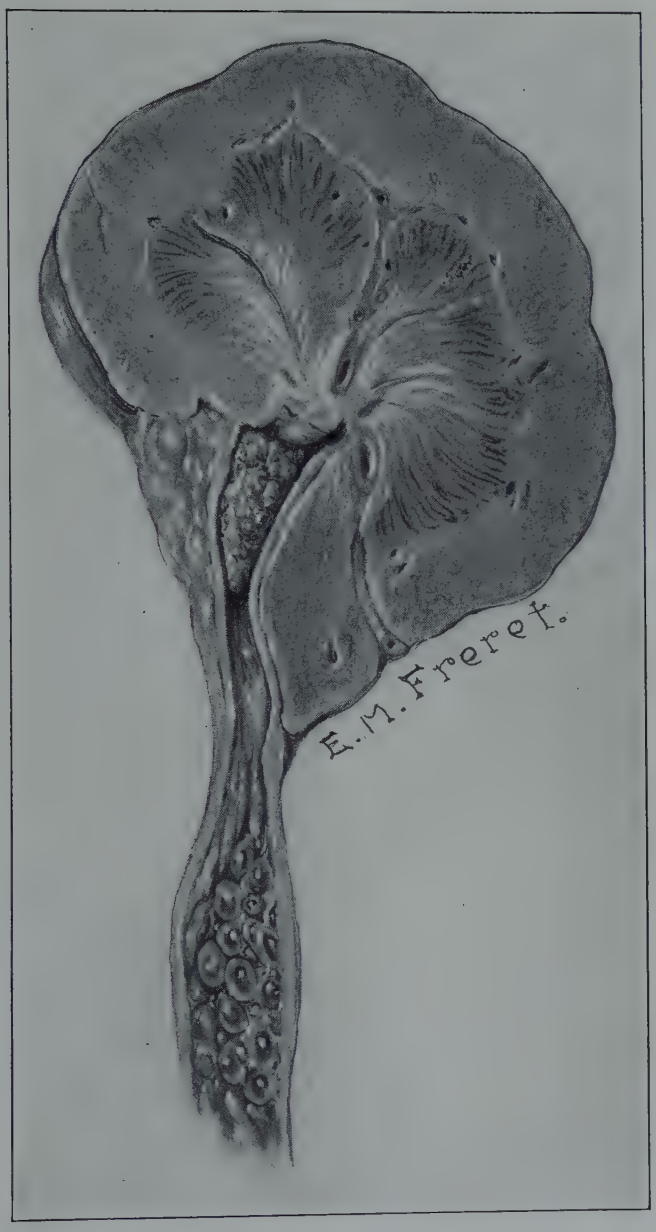

PLATE XIII.—APLASTIC KIDNEY, SILENT CALCULUS, URETERITIS CYSTICA.

URINE

			Pus.	*Blood.*	*Both.*	*None.*	*Total.*		
23 with calculus	Typical symptoms with calculi	+ sand *	1	1	1	1	4	8	= (34.78%)
		0 sand	1	2	0	1	4		
	Symptoms vague or referred to other points than site of calculus	+ sand	2	1	2	0	5	15	= (65.22%)
		0 sand	5	1	0	4	10		
			9	5	3	6			
57 negative	Typical symptoms— O calculi	+ sand	3	6	4	5	18	44	= (77.19%)
		0 sand	5	4	8	9	26		
	Vague symptoms— O calculi	+ sand	0	3	0	6	9	13	
		0 sand	1	1	2	0	4		
			18	19	17	26		80	

* History or present evidence of the passage of stone, gravel, sand, or crystals.

Our means of diagnosis may be summed up under the following heads, in the order of their employment:

1. The patient's history
2. Physical examination and urinalysis
3. Radiography
4. Substitutes for radiography
5. Ureteral catheterism
6. Exploratory operation

Patient's History.—The presence of calculus is suggested by history of the passage of stone, of renal colic, of anuria, or by the presence or history of stone in the bladder. Every case of pyelonephritis is suspected to be calculous until the absence of calculus has been proven by radiography. Yet how misleading the history may be is shown by the table given above.

Physical Examination and Urinalysis.—The presence of stone in the bladder or of renal infection suggests the possibility of renal or ureteral stone. It is exceptionally possible to palpate through the vagina or the rectum large stones incarcerated at the lower end of the ureter.

Urinalysis suggests stone when crystals of uric acid or oxalate of lime are present in great numbers, especially if these are found in the rounded forms. A relatively high percentage of urea in relation to the urinary specific gravity is suggestive of stone, and the presence of blood-cells with crystals in the urine is peculiarly suggestive. Yet the passage of crystals alone often causes renal colic and may even produce a macroscopic hemorrhage. Moreover, while the rule is almost universal that, so long as stone is present in the upper urinary tract, there are constantly a few blood-cells in the urine, I have known two notable exceptions to this rule: *i.e.,* two cases in which stone was present but the urine showed no red blood-cells. On the other hand, microscopic traces of blood are constantly found in the urine as a result of so many conditions other than renal stone that the presence of blood-cells alone is no more than suggestive.

Appendicitis and ureter stone give symptoms so closely simulating each

other that special signs, notably blood and pus in the urine, have been sought to distinguish them. But appendicitis can cause hematuria through involvement of the lower ureter in the inflammation, or by causing toxic or bacterial nephritis.[7]

The presence of tubercle bacilli in the urine does not exclude stone, for secondary stone may form in a tuberculous kidney or tuberculosis attack a calculous one.

Radiography.—A good radiograph is *prima facie* evidence in the diagnosis of ureteral and renal stone (Figs. 30, 31). For it shows the size, shape and disposition of calculi. But an x-ray plate is by no means infallible. It may fail to show a stone, even though the plate be perfect. And it may show shadows suggestive of stone when no stone is actually present. Real familiarity with radiography is required for the interpretation of plates. A few of the elementary requisites are detailed in Chapter VIII, but this real familiarity can only be gained by long experience.

But an unsupported radiogram does not prove the presence of stone any more than a negative radiogram proves its absence. The radiogram has only the weight of circumstantial evidence. The real proof rests with the ureter catheter, which discloses the depressed renal function resulting from the pressure of stone, and the urogram which shows the dilatation of the ureter, the pelvis or the calix about and above the stone and proves, if taken stereoscopically, that the stone lies in the dilated cavity.

Should the radiogram, renal function and urogram not support each other and establish a physiological and anatomical diagnosis, then the wax-tipped catheter, the radiogram taken transversely or gall-bladder visualization should be employed.

The Wax-tipped Catheter.—The wax-tipped catheter, or wax-bulb catheter is a ureteral catheter upon which has been molded a smooth bulb of beeswax. The bulb is made so large that it will just slip through the cystoscope. It is placed just proximal to the last eye of the catheter unless it has been found that the catheter will not pass the point where stone is suspected, in which case the bulb is placed at the catheter tip. Kelly, who introduced these bulbs, employed his large open tube cystoscope and assumed that the bulb could not be conveniently employed through the closed tube because of the inevitable scratching from contact with the sheath. But I have so employed it for several years as a routine procedure. The bulb must be inspected through a magnifying glass before its introduction so as to note any irregularities upon the surface. It is then introduced in the ordinary manner, and on withdrawal dried and again inspected through the glass. Scratches made by the cystoscope are readily identified, by their smoothness, from the scratch due to stone, which is irregular and rough, like the scratch of a claw.

Geraghty and Hinman[8] failed to show the stone by radiography in fifteen

[7] Von Frisch, *Ztschr. f. Urol.*, 1912, Supplement.
[8] *Surg., Gynec. & Obst.*, May, 1915, xx, 515.

out of sixty-seven cases of ureter calculus: seven of these were subsequently passed, six others were diagnosed by the wax-tipped catheter, and two by operation.

Ureter Catheter Diagnosis.—The cystoscope may reveal bulging or inflammation of the intramural portion of the ureter due to the presence of stone. A stone may be seen projecting from the ureter mouth, or it may be recognized by impact upon the ureter catheter introduced into that channel, though it is usually quite impossible to distinguish the obstruction due to stone from that due to any other cause.

The primary function of the ureter catheter is the study of renal physiology rather than the study of renal pathological anatomy. The diagnosis of renal and ureteral stone is not complete without catheterization of the ureters for the purpose of studying the renal function and the presence or absence of inflammation of the kidneys. Though the results obtained vary beyond the scope of any tabulation we may attempt to classify them loosely as follows:

The impairment of kidney function by even a series of renal colics may be singularly slight. For a few hours after the colic the phenolsulphonephthalein output may be extremely low, but it may then return to normal. The urine obtained by ureter catheter after a renal colic is likely to show red blood-cells, and may show pus. But the presence of red blood-cells must be disregarded on account of the possibility of their having been due to a scratch from the catheter.

The combination of a small stone in one ureter causing colic, and large or multiple stone in the opposite kidney is not uncommon. The renal stones are "silent" in that they do not engage in the ureter and hence cause little or no pain, but the kidney occupied by the renal stone is usually more gravely infected than its fellow, and its function often gravely and surely permanently impaired, while the kidney whose ureter is blocked and whose renal colic has brought the patient to the urologist, has suffered but a temporary depreciation of function, is probably little infected, is in short the kidney that must in future support life. Here is a complex grave emergency, the diagnosis of which must be recognized from a glance at the radiogram. The ureters must be immediately catheterized with the greatest gentleness for fear of adding to the gravity of the patient's illness, and if the better, the colicky, kidney is not functioning well, operation is required at once. In as much as the colicky kidney is our chief concern, the primary operation is to relieve it by removing the ureter stone. It is relatively imprudent to attempt relief by ureter catheter or bougie since this entails the danger of more colic and very probably grave infection of the good kidney. The knife is safer.

But if the stones are bilateral and the better kidney neither infected nor at the moment in acute retention while its fellow is a mere sac of pus, it may seem wiser to remove the pus sac first so as to eliminate a source of possible infection and two or three weeks later remove the stone from the uninfected pelvis or ureter of the remaining kidney.

Urography.—Whenever the diagnosis of renal or ureter stone cannot be completed without it, and no danger to life is to be apprehended, urography completes the diagnosis. The exceptions are so few that urography should be regarded as part of the routine diagnosis (Figs. 28 to 32; 88, 89).

Diagnosis of Stones Invisible to Radiogram.—The foregoing methods of diagnosis are adequate for all but "negative" stones and very wee ureter stones. The "negative" stone is one the density of which is so nearly that of the body tissues that it does not show by x-ray; it contains little calcium and is usually a urate or uric acid stone. Though cystin stones were at one time reputed "negative," actually the radiogram shows them perfectly well. Such stones are so smooth that most of them slip silently down the ureter and, if not retained in the bladder by prostatism, escape through the urethra unobserved. Moreover, that minority of urate stones that are retained in the kidney pelvis grow slowly and usually excite neither pain, bleeding, nor infection and are found at autopsy when the patient dies of intercurrent disease. But exceptionally they excite symptoms as they lodge in the pelvis of the kidney or obstruct the ureter. Under such circumstances the radiogram is negative, the ureter catheter reveals a diminution of function of the affected kidney, and perhaps infection, and the urogram depicts a dilatation characteristic of stone, in which the urate stone is faintly shown "negatively"; *i.e.*, less dark than the shadow of the injected fluid (Fig. 34).

FIG. 88.—UROGRAM OF RIGHT KIDNEY. LARGE SILENT STONE OF LEFT KIDNEY. PYONEPHROSIS.

If the kidney is filled with thick pus a small stone in it is quite invisible.

The Wax-tipped Catheter.—We have now achieved a diagnosis of all stones except the very smallest. Yet these, blocking the ureter, may excite the most intense colic. The stone is so small that the radiogram does not detect it, the ureter catheter slips by it, the kidney is not infected, its function is unimpaired. The urogram is negative. The patient has unquestionably had a severe colic, yet he now seems quite well. Perhaps his stone has passed. But perhaps it has not. In spite of every precaution, even straining the urine, stones of a size quite visible to the x-ray may escape from the ureter without exciting a twinge of pain, much more so these wee ones. But as the stone passes into the bladder it often leaves a trace of its passage at the ureter mouth which is found swollen, as compared with its fellow, or lacerated. If the ureter mouth is found normal at the first examination after a colic, the ureter should be recatheterized, this

time with a wax-tipped catheter in the double hope of diagnosing the condition by a scratch on the wax and of dislodging the stone and so expediting its exit.

But even the wax-tipped catheter is not infallible. One is occasionally reduced to making a diagnosis of ureter stone by exclusion. We are confident a stone has been in the ureter. We do not think it has passed. We have the choice of removing a "chronic appendix" or of awaiting the issue. The latter is the proper decision. Keep the patient under observation. If colic does not recur, good! If it does, the stone is almost sure to pass. If the stone does not pass, the whole examination is to be repeated. One is often tempted under these conditions to lend undue weight to evidence, whether symptomatic (*e.g.*, indigestion) or radiographic (bismuth meal) which may be suggestive of appendicitis. But the diagnosis of afebrile chronic appendicitis should not be made until repeated catheterizations of the ureter have failed to relieve the symptoms by dilating a stricture or releasing a stone.

FIG. 89.—CALCULOUS PYONEPHROSIS.
An attempt at nephrectomy had been made three years before. Loin sinus. Pyelogram through sinus (stone fragments shown in insert). Nephrectomy successful.

Exploratory Operation.—Calculous anuria, and rupture of the ureter are the only two conditions that so immediately require operation for simple drainage as to warrant the neglect of a preceding ureter catheterization. But if the facilities are at hand, a preliminary ureter catheterization is desirable even in these conditions.

Apart from such therapeutic emergencies, exploratory operation is absolutely contra-indicated.

Differential Diagnosis

Let us dwell only upon three important points, viz.:

1. The possibility of "renal" colic without stone
2. Differentiation between stone and appendicitis
3. Differentiation of calculous anuria

Pseudorenal Colic.—I have reported cases [9] in which the passage of crystals or blood-clots from the kidney, intestinal colic, and vesiculitis precisely resembled

[9] *Tr. Am. Ass. Genito-Urin. Surg.*, 1906, i.

renal colic in their subjective symptoms. Biliary and appendicular colic and Dietl's crises also simulate true renal colic. Many physicians cherish the delusion that such pseudorenal colics are not as intense as the colics due to stone and do not, for example, require morphin. But in intensity there seems little choice between them. The diagnosis must be made as above described and with little regard to the intensity of the paroxysm.

Stone and Appendicitis.—Ureteral stone, arrested at or near the pelvic brim, is only one of many conditions which is frequently mistaken for appendicitis. Conversely, the inflamed appendix may not only excite hematuria from toxic nephritis, bacterial nephritis or involvement of the ureter in the inflammatory process; it may also excite any of the subjective symptoms, such as renal colic, frequent and painful urination and lumbar tenderness, that pertain to these conditions.

The method of diagnosis has been sufficiently described. Circumstances will occasionally remind one of the truth of the aphorism that *the usual justification of the operation for chronic appendicitis is the subsequent silent passage of a stone from the right ureter.*

Diagnosis of Calculous Anuria.—Anuria may be due to many causes. The terminal anuria of renal insufficiency, whether calculous or not, and the acute anuria of toxic nephritis do not present the "silent" clinical picture of calculous anuria. But hysterical anuria may be quite confusing. Thus Gordon [10] has reported a case of hysterical anuria lasting two days and cured by suggestion, while Grenier [11] saw a hysterical young woman through five attacks of anuria lasting respectively two, four, six, eight, and fifteeen days.

With all the facilities that the modern hospital affords, the diagnosis of calculous anuria is not difficult. X-ray, meatoscopy and urography give us a complete picture. But the condition is an emergency one and if encountered "in the field" may require emergency operation to save the patient's life. Under such circumstances and with a reasonable basis for the diagnosis of calculous anuria, the surgeon is justified in operating without any preliminary special examination.

TREATMENT

Prophylactic.—See Chapter XXVI.

Palliative and Symptomatic.—The patient suffering from renal calculus may require palliative treatment under the following conditions:

1. During an attack of renal colic
2. During a period of quiescence

Renal Colic.—Renal colic calls for the relief of pain, not only as a means of alleviating suffering, but also for the purpose of relaxing the ureteral spasm

[10] *Med. Rec.*, 1900, lviii, 289.
[11] *J. de méd. de Bordeaux*, 1902, xxxiv.

about the stone, and expediting its passage into the bladder. Morphin should be given subcutaneously with a generous hand, and the patient put to bed and swathed in hot blankets if the attack is severe. Sometimes a colon irrigation seems to help to dislodge the stone.

If the attack soon subsides the patient should be radiographed and cystoscoped for a complete diagnosis, and in the hope that the passage of the ureteral catheter will dislodge the stone. Thereafter, if only a small ureter stone is discovered, the passage of this may be expected without more than a series of bearable colics. But several other contingencies may arise.

Pain continuing for several days, even though not very severe, indicates continued blocking of the ureter, threatening to destroy the kidney and imperatively requiring relief. Fever accentuates the need.

If the radiogram shows stone too large to pass, or other conditions requiring operation, this may better be performed at once.

Calculous Anuria.—As soon as calculous anuria is diagnosed, *i.e.*, as soon as it is known that there is anuria, and that the anuria is due to calculus, operation should be performed. Delay is inexcusable except for the purpose of making the diagnosis more accurate. If the patient is seen in the first day or two of the anuria, he should be x-rayed for the purpose of locating the stone, and an attempt should be made to relieve the anuria by the passage of ureter catheters. No more than twenty-four hours should be spent in this effort, and if the anuria has lasted for more than three days, not even this waste of time is permissible—operation must be performed at once.

Watson and Cunningham collected 205 cases of calculous anuria, of which 95 were operated upon with 46 per cent mortality, 110 were not operated upon, with 72 per cent mortality.[12]

Huck [13] states that operation before the fourth day gives a mortality of 25 per cent; before the fifth day, 30 per cent; before the sixth day, 42 per cent.

No matter how perfect the x-ray picture, there must always remain some doubt as to the condition of the kidneys. Therefore, the x-ray findings should be neglected and bilateral pyelotomy performed solely for the purpose of saving the patient's life and removing any stones that may be found in the pelvis of the kidney.

The operation consists in bilateral simultaneous pyelotomy, *i.e.*, drainage of the two kidney pelves. This is to be done in the most expeditious way possible and without reference to the finding of stone. The object of the operation is to save life. If there is bilateral stone, one of the stones is often in a relatively inaccessible position in the lower ureter; and in any case, even though a complete preoperative diagnostic exploration is possible, the delay entailed by the attempt at removing all the stones is precisely what may cost the patient his life. The anesthesia of choice is spinal.

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[12] *Genito-Urinary Diseases*, 1908, Vol. II, 193.
[13] Quoted by Walker, *Genito-Urinary Surgery*, 1914, p. 282.

In the few operations I have performed, I have almost invariably found stone on one side and failed to find it on the other. Two of these stones have subsequently silently passed into the bladder—the largest stones, except one, I have known a ureter to deliver. Thus, though the operation is not explicitly done for the purpose of extracting all the stones, it usually achieves that end incidentally even if performed with the greatest rapidity possible.

As a matter of fact, I have not had to reoperate any of the patients thus operated upon.

During a Period of Quiescence.—The treatment of calculus during a period of quiescence depends upon the situation, size and number of the stones, condition of the opposite kidney and general condition of the patient. The following rules may be laid down:

Ureteral calculi may be expected to pass if no more than 1 cm. in diameter. Their passage may be encouraged by the measures detailed in reference to the treatment of renal colic. But a patient with a calculus in the ureter is in danger at any time of having an acute ureteral stoppage that may result fatally if not promptly met by surgical intervention.

Larger ureteral calculi should be promptly operated upon. The stone may pass, but this it can do only at the cost of grave impairment of renal function.

The problem of the silent renal calculus is one that requires the best of surgical judgment, tempered by the knowledge that even if no stone is present in the opposite kidney, one is likely to form there and, the formation of the pelves of opposite kidneys being much the same, this is likewise to be retained.

Small renal calculi, single or multiple, of a size calculated to pass down the ureter, should not be operated upon unless suppuration, obstruction or pain demand it. If, lying silent in a calix, they can be found at operation only at a cost of destruction of renal parenchyma, more than is likely to result from their passage.

If all calculi are actually removed by operation recurrence is due either to retention or to phosphatic stone formation.

Phosphatic renal calculi almost always relapse after pyelotomy or nephrotomy. Prolonged drainage and irrigation through the loin, followed by lavage of the renal pelvis, may delay, but are unlikely to prevent this relapse.

Large silent renal calculi, being usually phosphatic, at least in their outer shell, are so likely to relapse after operation that it is generally wiser not to attack them except by nephrectomy. Not infrequently they remain silent for many years.

Radical Treatment

Much has been said of the choice of radical treatment in the preceding paragraphs but the overshadowing element in deterring one from operating upon renal stone is the presence, the potential presence even, of calculus in the

opposite side. Bilateral stone should be operated upon boldly if at all, yet only after duly weighing the patient's prospects of life and comfort with and without operation.

The radical treatment of renal and ureteral calculus consists of three operative procedures: nephrolithotomy, nephrotomy, and nephrectomy. Nephrolithotomy (pyelolithotomy or ureterolithotomy) is incision of the kidney (pelvis or ureter) for the purpose of extracting a stone. The term has been restricted to operations performed upon the aseptic kidney, to distinguish them from nephrotomy performed upon the suppurating kidney. This distinction is valuable from a surgical point of view. The term nephrolithotomy, therefore, will be employed to designate extraction of a stone from a non-suppurating kidney, while nephrotomy, in this connection, will imply lithotomy of a suppurating organ.

The general indication for operation is the presence of a stone too large to pass down the ureter. If the calculus is too large to pass of itself it must be removed by the surgeon. In the preceding paragraphs the modifying circumstances have been discussed—the delusive nature of the calm succeeding a renal colic, the imperative necessity for operation during anuria, the danger of delay when the kidney is suppurating.

The mortality from nephrolithotomy, pyelolithotomy and ureterolithotomy does not run above 2 to 4 per cent. Such a prospect, with its assurance of future safety, its lack of present danger, and its unimportant discomforts, outweighs a single renal colic, and is not for a moment to be compared with the progressive unsafety and discomfort to which a patient subjects himself by refusing operation.

The advantage of early operation, before the kidney becomes infected, is still further enforced by the relative mortality of nephrolithotomy, nephrotomy, and nephrectomy. Nephrolithotomy—the removal of a stone from an uninflamed kidney or ureter—has, as remarked above, a mortality of 2 to 4 per cent. Nephrotomy—the incision of a septic kidney—has a mortality of 10 to 25 per cent, while the mortality of nephrectomy in like conditions runs from 20 per cent upward. Add to this the mortality of nephrotomy for calculous anuria and the conclusion is obvious that the patient who refuses surgical relief while the kidney is yet uninflamed spurns a comparatively safe and sure cure and subjects himself to a disease which, apart from its other dangers and discomforts, may at any moment bring him to a critical condition of renal obstruction or suppuration, from which he can only escape by submitting to an operation many times more dangerous and distressing than the one he seeks to avoid. Furthermore the longer operation is deferred the greater prospect is there of irreparable damage to the kidney, and also the persistence of stricture or obstruction in the pelvis or ureter calculated to cause prompt relapse of stone and persistence of fistula.

The really important decisions in reference to treatment of renal and ureteral calculi bear upon two points:

1. When the diagnosis is uncertain and all the resources of the urologist have been drawn upon without avail, shall the patient be operated upon or shall one await further developments?

2. When a diagnosis of stone is established, what stones should be let alone, what stones should be treated by mechanical means in the effort to expedite their passage out of the kidney pelvis and down the ureter, what stones should be operated upon?

1. In the absence of precise diagnosis, operation should be deferred as long as possible. Exploratory operation for stone is almost always disastrous. Operation should be preceded not only by a diagnosis that there is stone, but also by a complete renal function and urographic exploration which will imprint upon the surgeon's mind a precise physiological and anatomical picture of the condition with which he purposes to deal.

Notable exceptions to the above rule are cases of calculous anuria occurring far from hospital, renal colic so intense and persistent as to threaten life, occurring under the same circumstances, and pyonephrosis; for chronic pyonephrosis requires nephrectomy whether stone be present or not.

2. Given the complete diagnosis of stone, the decision to operate is subject to many conditions. It is unpardonable cruelty to take advantage of the horror inspired in the patient by the announcement that he has stone to lead him to an operation which will probably do him no good and may do him great harm. In laying down the following rules we recognize that the skilled surgeon may be justified in violating almost any one of them; the inexpert has not the same liberty.

Uninfected silent stones in the kidney calices should not be operated upon until they have grown large enough—at least 2 cm. in diameter—to be readily detected by palpation with one finger inside the kidney pelvis and one outside the kidney. The more numerous the stones, the more difficult will it be to discover and remove them all. Such an operation requires considerable experience. If the stones are bilateral, it is not probable that any surgery, unless for an emergency stoppage, can promise the patient a longer life than he may expect without surgery.

Infected silent kidney stones are often not worth operating upon because the urea splitting infection that has occasioned them cannot be eliminated by operation and the removal of the stone can only diminish the prospect of further stone formation in so far as it reduces the kidney power of concentration below that point where it will excrete urea in sufficient density to permit of further formation of phosphates. Broadly speaking, the infected silent renal stone should be operated upon only by nephrectomy and on condition that the opposite kidney is free from stone.

3. Stones in the kidney pelvis or ureter that excite symptoms must come away. One may await their spontaneous passage if they are no more than 0.5 cm. in the narrow cross section and if the symptoms do not date back further

than six months and are not such as to threaten graver destruction of kidney function than would probably result from operation.

An attempt may be made to accelerate the passage of such stones by ureter catheter manipulation if (*a*) there is no infection, (*b*) the catheter will go by the stone, (*c*) the treatment is not continued after any such attempt excites infection or any two or three such attempts fail to dislodge the stone.

If the stone is not small enough to pass or if it has been retained so long—six months being accepted as the limit—that the future prospect is rather destruction of kidney function than passage of stone, and the stones are unilateral and the function of the opposite kidney adequate to sustain life, operation is called for in the hope that it may extract the stone and save the kidney, and with the assurance that it will at least permit nephrectomy if unexpected complications should develop.

Bilateral stones causing symptoms and which would call for operation if they were unilateral, form the most intricate problems and as a matter of fact, the decision to operate or not to operate upon a given case, as well as the manner of operation, will depend upon the experience of the individual surgeon. With good or evil fortune his impressions will change and, if he watches closely, he will find himself at one time more bold and at another more prudent. The rules given for unilateral stone obviously do not apply to bilateral stones. Nephrectomy is not the operation of choice.

Certain of the problems presented by bilateral stone may be solved on the following basis:

1. If there is stone in one ureter giving symptoms and silent stone in the opposite kidney, the combination calls for removal of the ureteral stone either by the natural passage or by operation. When the kidney function has recovered from this, the opposite kidney may be attacked by nephrectomy or nephrotomy.

2. The renal function of an uninflamed kidney will be much more gravely impaired by operation than will the function of the infected kidney. Bilateral simultaneous operation should therefore be contemplated only for the relief of bilateral gravely infected kidneys. If bilateral operation is done on uninfected kidneys, the cystoscopic renal function test should be repeated after the first operation.

3. There has been much dispute as to which kidney should be operated upon first, the one showing the better function or the one whose function is more impaired. In establishing a basis for the answer of this question, one must not forget that the patient is likely to come for operation during a renal colic or shortly thereafter. Under these circumstances the ureteral stone causing the colic is likely to be on the side of the better kidney, yet the back pressure due to the stone is often so great as to impair the function of that kidney temporarily so much as to make it seem to be functioning less well than does its fellow. Hence the first rule in this connection is to distinguish between permanent and temporary impairment of function by retention. With this distinction made, it is generally preferable to remove the stones from the better kidney or its

ureter first so that it may be fortified to take on the burden of total renal excretion when the less healthy kidney is operated upon. But, if the better kidney is uninfected and the opposite one gravely infected, it is sometimes wiser to perform nephrectomy of the bad kidney first and later to attack the stones on the better side, thus minimizing the chances of infection to the uninfected kidney.

4. As has been said above, the more infected the kidneys are, the less badly they will react to an operation which, by cleaning out the pus for the moment and establishing drainage, sometimes permits them to function far better than would have been supposed possible. It is in such cases that one gets truly astounding results. I have three patients upon whom I have performed nephrectomy and hemi-nephrectomy leaving anatomically not more than half of one kidney and physiologically rather less than that. They are all able to lead somewhat restricted lives though they are all earning their own living. The operations were performed from five to ten years ago. They have been fortunate in surviving the immediate risk and in having no recurrence of stone. They suffer no symptoms and consider themselves adequately well.

Similar results are obtained by removing stone from the infected kidney remaining after nephrectomy. Indeed my proudest boast is a patient with solitary kidney whom I first saw in anuria. He was operated upon for relief of this, subsequently developed a phosphatic stone, thanks to wound infection, and a stricture of the ureter so tight that the lumen could only be reëstablished by intubating after the fashion employed for bile-duct drainage. These operations were performed more than ten years ago, since which time his urine has become and remained clear and he has been working as a laborer without any further illness.

CHAPTER XXVIII

CALCULI AND FOREIGN BODIES OF BLADDER AND URETHRA

VESICAL CALCULUS

Number and Shape.—Single vesical calculi are generally ovoidal in shape (Figs. 25, 80-88, Plate I).

Multiple vesical calculi are usually phosphatic, less frequently uric. In general, their number bears an inverse relation to their size. When few in number they influence one another's shape and grow to be many-sided rather than rounded (Figs. 84, 85). Hence when a stone passed spontaneously presents one or more flat sides or facets, the presence of other stones may be inferred.

Fantastic dumb-bell and other shapes are assumed by encysted calculi (Fig. 90), part of the stone taking the shape of the pocket which contains it, while the remainder protrudes irregularly into the vesical cavity.

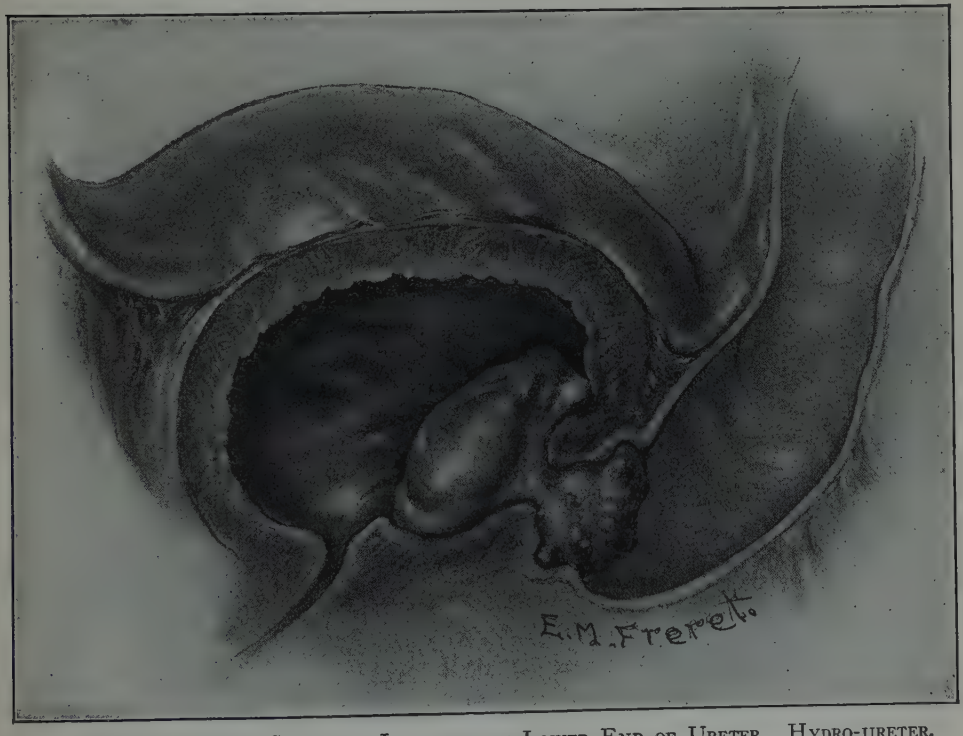

Fig. 90.—Mulberry Calculus Impacted at Lower End of Ureter. Hydro-ureter. Infection. Photostatic Incrustation Growing into Bladder. Pyoureter.

Size.—Partly on account of the infrequency of stone, partly on account of the surgeon's omnipresence, large stones are rarely seen in this day and in this country. The largest stone in my collection weighs 13 ounces. Randall[1] cites the authentic cases of large bladder stones, as follows: Deschamps, in a postmortem, 51 ounces, 6.5 inches long, 12 inches in circumference; Cline, having failed to extract and removing, postmortem, 44 ounces, circumferences 14×16 inches; Keiser, after a fatal suprapubic lithotomy, 64 ounces when fresh, later 56 ounces, circumferences 40×48 cm. Such large stones are always phosphatic.

Sex.—Not more than 2 or 3 per cent of bladder stones occur in women, if we except incrusted ulcers. I have operated on over seventy men and one woman; my father on 250 men and three women.

Source.—A few vesical calculi are formed in the bladder about foreign bodies, while others can be traced by the history of a renal colic as having descended the ureter and been caught in the bladder. But in the majority of cases no such clear history is obtainable. The predominance of urate calculi in the bladder is not due to the fact that they form there, but to their smoothness, which permits them to slip silently down the ureters.

Spontaneous Fracture.[2]—Spontaneous fracture is apparently due to long-continued dilution of the urine, which weakens the colloidal framework of the stone sufficiently to permit it to break into pieces. This rare phenomenon has been taken advantage of by the purveyors of various lithia waters. The claim that any water or drug will even probably cause spontaneous fracture of stone is not supported by experience. Moreover, when the calculus does break it is not to be expected that all the fragments will be expelled. One or more remain in the bladder, and around these as nuclei new stones will form. Almost all the reported cases of fracture have occurred in pure uric acid calculi. I have seen two such cases.

Symptoms

There is no symptom, no set of symptoms, absolutely and invariably pathognomonic of stone in the bladder, except the physical signs elicited by the surgeon's examination. Yet there is a certain group of symptoms which is very suggestive of stone. Chief among these are frequency of urination, pain, and hematuria, occurring by day and increased by exercise.

Frequency of urination and pain are mild at first, but if neglected, increase by fits and starts until they become intense. The distress is usually less during the night while the patient lies quietly on his back, and during the day so long as he is still. But every jolt induces spasm. When walking the patient moves slowly and gingerly, almost on tiptoes. Riding over a rough road or in a railroad train, or even walking downstairs, is misery. The pains are situated chiefly in

[1] Randall, "Giant Calculi of Bladder," *Am. Urol.*, 1921, v.

[2] *Cf.* Englisch, *Arch. f. klin. Chir.*, 1905, lxxvi, and Kasamowski, *Folia urolog.*, January, 1909.

the glans penis, along the pendulous urethra, and in the perineum. The desire to urinate is "imperative," *i.e.,* quite irresistible. As a result of some extra exertion or an acute infection, the patient, from time to time, has what is known as a *fit of the stone.* During this time he has to urinate as often as every ten or fifteen minutes day and night, so that he spends his time in one long spasm. This constant aching spasm is known as strangury.

When there is prostatic enlargement or the stone is encysted, the stone does not roll against the bladder neck and there is less pain, so that even with intense cystitis the paroxysms may be neither frequent nor severe. One of my patients carried two stones in his bladder for three years and yet never had any pain, though horseback riding made him bleed. At the French Urological Association in 1917 a number of cases were reported of large silent vesical calculi found in soldiers who had been two years in the trenches without other symptoms than pyuria.

In children certain special symptoms are associated with stone, notably priapism and a tendency to pull at the prepuce. Reflex pains in the back, testicle, etc., are due to prostatic irritation.

Hematuria, like the characteristic pain, is traumatic in origin, and is chiefly terminal. It is usually associated with pain, and the hemorrhage, though profuse, is usually short-lived. Later in the disease the straining due to cystitis may make the hematuria quite continuous.

Sudden stoppage of the urinary stream is a symptom of stone which is neither characteristic nor common. It is caused by the stone rolling into the vesical orifice and plugging it like a ball-valve. Striking cases, like that of Sir Henry Thompson, whose patient could urinate only while lying on his back, are most uncommon. Prostatics with stone do not show this symptom, and it may be caused by prostatic or vesical tumor.

Diagnosis

In these cystoscopic days when every obscure case of bladder or renal infection submits to cystoscopy and radiography, one is not surprised occasionally to find an unlooked-for bladder stone. Stone is suspected when the previously related symptoms are found. If the bladder is much inflamed, the cystoscope may not readily distinguish a stone from a sloughy tumor, or from a tumor incrusted with phosphates. If there is any doubt the cystoscope may be used as a searcher to tap against the stone. The sensation imparted distinguishes the solid stone. Large stones can be readily diagnosed by tapping with almost any urethral instrument excepting a soft rubber catheter; even the woven catheter will strike its end against the stone and give the characteristic impact.

Radiography is peculiarly fallacious in the diagnosis of bladder stone. That the renal and ureteral calculi show so much better is due to two circumstances: The bladder stones are more often composed of urates and the tissues about the bladder, lacking the gas in the colon, do not throw the stone into relief. Bladder

stone is disclosed by cystogram with air distention of the bladder. If two widely separated stones are seen, one of them is in the lower ureter or in a diverticulum.

Small stones are very elusive, and are not found readily by the old-fashioned searcher while the encysted stone and the stone behind the prostate elude this as well. For these reasons the stone searcher has quite fallen into disrepute.

The presence of bladder stone leads to the suspicion of renal stone; this should be proven by x-ray.

Prognosis

Unless the stone is small enough to be viable through the urethra, there is only one prognosis—it will certainly remain, and the symptoms will inevitably grow more severe until it is removed by operation.

Cystitis is the inevitable result of bladder stone. Pyelonephritis, infected hydronephrosis, pyonephrosis follow.

Treatment

The treatment of stone in the bladder is operative. The choice of operation depends in some measure upon the patient's condition, in some measure upon the surgeon's skill. The surgeon may choose between three operations: litholapaxy, suprapubic and perineal lithotomy.

The performance of litholapaxy requires a training and an opportunity for performing the operation with relative frequency which few, even among specialists, can command. Litholapaxy is the operation of choice at the hands of a skilled operator for all uncomplicated and relatively small stones in the bladder. Each surgeon must decide for himself what type of case he considers suitable for the operation. In India, where bladder stones are extremely frequent, litholapaxy is preferred above all other operations, even for large stones. In this country, where stones are relatively few, and usually due to retention of urine, many specialists do not perform litholapaxy at all. I prefer the operation in adults for uncomplicated stone up to about a diameter of 5 cm.

Suprapubic lithotomy is the operation of choice for large stones, for children, for stones the result of prostatism, or other pathological conditions about the bladder requiring operation. Its mortality is slightly greater, its convalescence longer than litholapaxy. I have never lost a patient after litholapaxy, though I have several times had to repeat the operation on account of fragments left behind at the first crushing and have occasionally had to complete it by suprapubic lithotomy.

Perineal lithotomy is the operation of choice when some condition in the urethra, such as stricture, requires a perineal section. As an operation it consists merely in the removal of stone with a "scoop" through the perineal incision.

The mortality of operations upon large bladder stones is extremely high, because these cases invariably have a gravely impaired renal function through chronic renal infection. Preliminary phenolsulphonephthalein test discloses this condition and indicates the necessity for preliminary prevesical section and caudal anesthesia.

FOREIGN BODIES OF THE BLADDER

Foreign bodies may enter the bladder down the ureter, through the wall of the bladder, or up the urethra.

Ureteral.—Crystals, stones, blood-clots, shreds of tissue, descend the ureter and may be caught in the bladder.

Parietal.—Apart from the substances which may be introduced through wounds, there are two types of parietal foreign bodies. One consists of the gauze sponges, etc., that may be left in the bladder at the time of operation, and the silk sutures with which the bladder may be tied and which work their way into that organ. The second class of parietal foreign bodies reach the bladder through the bursting and emptying of the abscess containing them into the bladder, or such objects as pins may, of their own impetus, migrate into the bladder without suppuration.

Urethral.—Foreign bodies are introduced into the bladder through the urethra by the insane and the pervert. This practice is not common in the United States. These foreign bodies are much more likely to slip through the short urethra of a woman than that of the man. Consequently, they are more commonly found in women's bladders. The substances usually employed are chewing gum, hairpins, and hat pins.

In this manner every substance that the urethra will admit has at one time or another been introduced into it, and been found in the bladder subsequently. It were a waste of time, therefore, to attempt any specific enumeration. The curious may refer to the exhaustive monograph of Englisch.[3]

A generation ago it was not uncommon for catheters to break off inside the bladder; improvement in their manufacture makes this accident most uncommon nowadays, but our intravesical operative instruments sometimes, though rarely, break.

Blood-clots and bits of sloughing tissue left in the bladder after operation form the nuclei of postprostatectomy calculi.

Results.—The foreign body may remain silent in the bladder for a considerable length of time, especially if it be small, rounded or soft. But sooner or later staphylococcus or streptococcus infection occurs, phosphatic incrustation ensues, and a phosphatic stone develops around the foreign body as a nucleus (Fig. 86). The symptoms thereafter are those of stone. Such stones are usually best attacked by cystotomy, though gum, pins, etc., may be extracted by means of the cystoscopic forceps.

[3] *Deutsche Ztschr. f. Chir.*, 1906, lxxxix.

Pilimiction

The one special type of vesical foreign body which has received distinguished mention in the past is best known under the title of "pilimiction"—the urination of hair. My father had one such case, an insane patient, who introduced the hair into his bladder through the urethra; but it may be set down as an almost universal rule, if the patient urinates hair, or stone formed upon hair, that this comes from a dermoid cyst which has ruptured into the bladder. Heller [4] has collected fifty-seven examples of this condition. I have seen one case which was readily identified by cystoscopy. The treatment required is excision of the dermoid cyst.

Fig. 91.—Pilimiction.

An ovarian cyst has ruptured into the bladder. Discharge of hairs coated with phosphates. Scorned by an internist who told her she had swallowed the hairs. Cured by removal of the dermoid.

URETHRAL FOREIGN BODIES

Foreign bodies may enter the urethra at either extremity or may develop in and about the canal.

- From without: Fragments of surgical instruments. Substances introduced by the intoxicated, insane, or sexually perverted.
- From within: Renal or vesical calculi, or any substance which might form a nucleus for such calculi.
- Originating in or about the canal: Stone: Formed about a foreign body, or in an ulcerated spot, pocket, or fistula.

Varieties.—The most varied substances are found in the urethra, introduced by the patient under the influence of that perverted and depraved sexual instinct which affects the male of all ages who gives up his mind to impure thoughts and whose sexual necessities are not gratified.

Seeds, stones, beads, beans, peas, nails, pins, needles, hairpins, slate-pencils, portions of glass, wax, cork, and a host of other substances are thus introduced into the meatus and, slipping beyond the reach of the fingers, are not infrequently swallowed by the urethra. Broken catheters and bougies and instru-

[4] *Ztschr. f. Urol.*, 1913, ii, 1.

ments left tied in, if not well fastened, may slip past the meatus and travel toward the bladder. Their tendency is to slip persistently onward, not because of any urethral suction or peristalsis, but merely because they are introduced blunt end first, and consequently, unless quite round, the outer end is likely to be the sharper. Therefore every erection or effort at extraction, if it move the foreign body at all, pushes it inward. Rounded bodies, such as beans or pebbles, lie in the natural pouches of the canal (fossa navicularis, bulbous urethra) or become arrested by stricture.

If foreign bodies are not removed, one of three consequences follows: (1) They travel on into the bladder and form a nucleus for stone there; or, (2) stone forms around them in the urethra; or, (3) they cause urethritis, retention of urine, and finally either become encysted or ulcerate their way out, leaving fistula and stricture.

Treatment.—If the body be long and soft, as a catheter, piece of food, etc., it may be transfixed with a stout needle through the floor of the urethra and the canal pushed back over it, like a glove over a finger, as far as possible, when it may be transfixed again, and so urged forward until it reaches the meatus. In manipulating with forceps, if the finger on the outside can detect and get behind the foreign body, nothing should divert the surgeon from keeping up pressure at that point in order to prevent his instrument from pushing the offending substance still deeper into the canal.

If the foreign body lies behind a stricture, the latter must be cut or dilated to allow the passage of an instrument suitable for extraction.

Pins and needles may be extracted through the floor of the canal if their blunt ends can be steadied. To remove a pin its point is pushed through the urethral floor and its shaft drawn out until the head can be turned so as to extrude through the meatus.

My father once extracted a pin with Thompson's divulsor, and Dieffenbach removed one from the membranous urethra by pushing it with his finger in the rectum until the point protruded through the perineum, and then forcibly extracting it.

All other manipulations failing, perineal section will reveal the position of the object and permit extraction. The penile or the scrotal urethra should not be incised for fear of fistula in the one case, infiltration in the other, necessitating further operative interference.

URETHRAL CALCULUS

Urethral calculus is usually a urinary calculus arrested in the urethra. Less often it forms *in situ*—*e.g.*, about a foreign body or behind a stricture. Prostatic calculi are mentioned below.

Englisch [5] has collected 113 cases of calculi in the prostatic urethra, 149 in

[5] *Arch. klin. Chir.*, 1904, lxxii, 487; *Centralbl. f. Harn. u. Sex. Org.*, 1904, xv, 18, 81, 135.

the membranous canal, 68 in the bulb, 103 in the penile and scrotal regions, and 41 in the fossa navicularis.

The calculi are elongated in shape, faceted if numerous, and if neglected grow to considerable size and form pouches in which they lie.

They may grow to enormous size. Thus Britneff[6] has collected from Russian publications records of urethral calculi weighing, respectively, 427 and 420 and 402 grams. Babes[7] records the spontaneous expulsion through the female urethra of a stone, 3×4.5×6.5 cm., weighing 76 grams. She was left with incontinence of urine.

Symptoms.—If the calculus comes from the bladder the onset of symptoms is sudden. As it enters the urethra during urination the flow stops suddenly, while a sharp pain is felt. A second effort may extrude it from the canal or only impact it more firmly, or it may fall back into the bladder and remain a vesical calculus. Once impacted, it may cause complete retention, or, more commonly, dysuria.

If, on the other hand, the stone forms *in situ*, the onset of symptoms is insidious. First, there is slight gleet and some difficulty in urination. The gleet becomes slowly worse, and finally periurethritis occurs, which goes on to extensive suppuration and fistulization.

Periurethral calculi may remain latent for a long time, until they obtrude upon the lumen of the urethra or excite suppuration in the pocket within which they lie.

Diagnosis.—A sharp attack of urethral colic is unmistakable, but the less acute conditions just described simulate stricture of the urethra; indeed, stricture and stone often coexist. The mistake is not a vital one, however, for any attempt at dilatation will evoke a grating sound characteristic of stone, and the calculus may be felt between the instrument and the finger externally.

Stone in the prostatic urethra throws an x-ray shadow in the midline. Prostatic calculi lie to each side of the mid-line.

Treatment.—In acute cases an attempt may be made to push the stone back into the bladder if it has not passed the membranous urethra; or, if it has passed, the anterior urethra may be distended with olive oil and the stone worked forward to the meatus, whence it may be extracted by meatotomy. When these methods fail external urethrotomy succeeds.

Periurethral calculus calls for external urethrotomy to remove the stone, to excise the pocket in which it lies, and to divide the stricture.

PROSTATIC CALCULI

Urinary calculi may lodge in the prostatic urethra or phosphatic incrustations may form on granulations in the canal or in a fistula leading from it. These are urethral rather than prostatic calculi.

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[6] *Rev. clin. d'urol.* Sept., 1912.
[7] *Ibid.*, March, 1913.

True prostatic calculus is a concretion formed of phosphatic salts and epithelial detritus in the acini of the gland. Such calculi are not uncommon in men past middle life; they form in the deeper portion of the glandular substance of the lateral lobes, many of them in the line of cleavage between that part of the lobe which is enlarged in prostatism and the so-called capsule.

Prostatic calculi are multiple, and usually do not exceed the size of a millet

FIG. 92.—MULTIPLE URETHRAL CALCULI.
Impacted behind a structure at the penoscrotal angle. (Rohde)

seed. They always contain lime salts and show extremely well by x-ray throwing a characteristic mottled shadow of a generally rounded outline which delimits the position of the prostate (Fig. 24). Exceptionally, the calculi attain a much larger size; I have known them to attain a diameter of 3 or 4 cm. Such large calculi are single or not more than three or four in number.

The common millet seed calculi are usually of no importance. Exceptionally they excite suppuration in the gland which may result in sclerotic prostatitis and contraction of the bladder neck.

The larger calculi cause a slight degree of prostatic obstruction; though I have never known this to assume any importance, producing mild bladder irritability with small quantities of pus in the urine. These cases often elude diagnosis because one does not think of the possibility of prostatic calculus. The first case of the kind I ever saw had had a kidney removed for tuberculosis and was being treated by lavage of the renal pelvis. The prostate in such cases may be only slightly enlarged, and this enlargement may then be put down as an ordinary hypertrophy. Careful palpation rarely reveals the irregular outline of the stone or of the scar tissue surrounding it. Indeed when the stones grow very large they produce precisely the effect of carcinoma of the prostate to the examining rectal finger. Indeed so precise is the simulation of carcinoma, both in the clinical picture and the enlargement as felt by rectum, that the only way to avoid mistakes is to x-ray every case of supposed carcinoma of the prostate in which the presence of carcinoma is not absolutely proven by palpable thickening in the middle line or by evidence of growth beyond the limits of the prostate gland.

The prognosis of prostatic calculus is relatively good. Although the stones do not usually attain any great size until the patient is quite aged, I have never known them to do any more harm than to cause pain which is usually quite bearable, epididymal or prostatic suppuration which may require operation, and sclerotic prostatitis.

The mere finding of prostatic calculi by radiogram calls for no therapy. If the stones occasion the symptoms of sclerotic prostatitis, they should be operated upon as such. I have operated both above and by the perineal route, and can most highly commend the suprapubic method of approach.

PREPUTIAL CALCULI

These resemble urethral calculi in that they may descend from above or be formed *in situ*, and have been exhaustively studied by Englisch.[8] I have never seen one.

[8] *Wien. med. Presse*, 1903, Nos. 47-49.

CHAPTER XXIX

GENITO-URINARY TUBERCULOSIS

Tuberculosis of the urinary and genital tract is spoken of very often as though it were a thing apart. This it is in the clinical sense. Its activity is not usually coterminous with tuberculosis processes elsewhere in the body, yet it is only one of the manifestations of tuberculosis, and a relatively rare one. Although urinary and genital tuberculosis often stand clinically alone there is always antecedent pulmonary tuberculosis. This is often inactive, and only to be revealed during life by the x-ray. Kocher records 451 autopsies on cases of tuberculosis of the urinary and genital organs, 80 per cent of which showed pulmonary lesions active or inactive. Waldschmidt [1] found 89 per cent in his series.

The association of urinary and genital tuberculosis is not very close in the female, but fully one-third of the men with tuberculosis of the epididymis have tuberculosis of the kidney as well.[2] G. Walker quotes Saxtorph's record of 10,016 autopsies with 547 cases of tuberculosis of the genital and urinary organs. The kidneys showed miliary lesions 342 times, the bladder four times. There were 205 cases of chronic tuberculosis. Walker further collected 279 cases of genito-urinary tuberculosis, in 184 of which the kidney was the first organ attacked, in eighty-eight the male genitals, in six the fallopian tubes, and in one the uterus.

Clinically the disease begins as a general miliary tuberculosis (which interests us not) or else it begins definitely in one of the organs involved. *In the urinary tract tuberculosis usually begins in the kidney* though exceptionally it may begin in the prostate. *It never begins in the bladder.*

In the genital tract it usually seems to begin in the epididymes though the site of the first invasion in the genital tract is not definitely known. I happen to have seen a number of cases of tuberculosis of the prostate without tuberculosis of the epididymis, and among the many cases of tuberculosis of the epididymis that I have studied none showed an absolutely normal prostate. For these, and for other reasons it is my impression that genital tuberculosis does not begin in the epididymis. Barney has argued both sides of this question.[3] He pins his faith on the biological fact that the epididymis is allied in origin to the kidney, and may therefore be considered an excretory organ, wherefore it may be infected from the circulation by tubercle bacilli. But Blandini and

[1] *Berl. klin. Wchnschr.*, Sept., 1912.
[2] *Ann. Surg.*, February, 1907, p. 249.
[3] *Am. J. Urol.*, December, 1911, vii, 459; *Boston M. & S. J.*, June 19, 1913, clxviii, 923.

T. Walker [4] have independently shown that a tuberculous epididymis may be experimentally produced by inoculating the urethra and bruising one of the testicles.

The origin of genital tuberculosis remains obscure because when cases are seen clinically, all of the genital organs are likely to be involved on one side, epididymis, vesicle and prostate.

What then is the source of genito-urinary tuberculosis, the blood stream, the lymphatics or coitus? Bulkley [5] favors the last theory, and has collected the evidence in its behalf. George Walker, however, says "it is possible that either the male or the female may become infected during coitus, but such an occurrence is extremely rare and the few instances which have been reported are open to doubt." A few voices are raised in favor of lymphatic origin of the infection, especially for a direct lymphatic invasion of the kidney from a tuberculosis of the base of the lung. But the majority speak in favor of an infection from the blood stream.

It has been believed that gonorrhea was a frequent cause of tuberculosis of the urinary and genital tract. Kummell, for instance, supports this view. But most observers agree that the association of the two diseases is either accidental or actually founded on erroneous diagnosis.

Age.—Genito-urinary tuberculosis is a disease of young adult life. It is commonest between the ages of fifteen and forty, though congenital cases both of renal and of epididymal tuberculosis have been reported, and George Walker's table of 375 cases shows twenty-nine above the age of fifty.

The Progress of the Lesions.—In the urinary tract the tuberculosis, beginning in the kidney, descends to the ureter, infects the bladder and perhaps the prostate, and then may ascend to the opposite kidney. In the genital tract, beginning in the prostate or vesicles, it extends first to one epididymis and later to the other, while the bladder may be infected directly from the prostate. Urethral and penile extension is extremely rare.

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[4] *Lancet*, 1913, clxxiv, 435.
[5] *Am. J. M. Sc.*, April, 1915, cxlix, 535.

CHAPTER XXX

TUBERCULOSIS OF THE KIDNEY

PATHOLOGY

Tuberculosis causes three recognized types of pathological change in the kidneys:

Acute miliary tuberculosis
Surgical tuberculosis
Toxic tuberculous nephritis

Acute Miliary Tuberculosis

Miliary tuberculosis of the kidney is but a part of general visceral tuberculosis. It has no interest for the surgeon.

Surgical Tuberculosis

Chronic or surgical renal tuberculosis begins and develops as a characteristically localized and unilateral disease. Infection of the opposite kidney is usually surprisingly slow to develop. Hallé and Motz found, for instance, in 131 post-mortem examinations, 89 unilateral cases of renal tuberculosis. The first lesion of chronic renal tuberculosis usually appears near the base of one of the papillæ [1] at the upper or lower pole of the kidney; the central portion of the parenchyma is singularly exempt from involvement. This first lesion is a characteristic tubercle, crowded with tubercle bacilli. The lesion spreads by three methods:

1. The lesion itself enlarges by extension of round-cell infiltration which ultimately breaks down to form a cheesy nodule or cyst; or, if it reaches the kidney pelvis, a tuberculous ulcer.

2. Lymphatic absorption gives rise to new tuberculous foci in various parts of the kidney, notably distributed in wedge shape from the original lesion toward the kidney cortex. These tubercles in turn coalesce and break down.

3. In the meanwhile, *toxic tuberculous nephritis* affects portions of the kidney not invaded by the actual tuberculosis and also ultimately affects the opposite kidney.

In the ureter the tuberculous lesions begin as localized superficial ulcerations

[1] *Cf.* Ekehorn, *Nord. med. Ark.*, 1914, xlvii, No. 12. And Wildboltz, *Ztschr. f. urol. Chir.*, 1914, ii, 201.

or a generalized infiltration which gives the surface of the ureter and pelvis a pebbled appearance. The inflammation soon extends to all the coats of the ureter causing a sclerosis and fibrolipomatous periureteritis and peripyelitis. The ureter is thus much thickened, its lumen narrowed and strictured and its elasticity lost. It is also shortened, its vesical orifice is retracted, its peristalsis lost (Figs. 96, 98).

In the renal pelvis the ultimate result of these sclerotic lesions is a progressive contraction. The contraction is often most marked at the orifices of one or more calices, resulting in stricture or actual occlusion at this point. The retention thus produced in the calices, together with the destruction of parenchyma by the tuberculosis itself, results in the characteristic gross change most pathognomonic of tuberculosis and distinguishing it from other forms of pyonephrosis, a *dilatation of the calices with contraction of the pelvis.* Exceptionally early ureteral retention may cause the pelvis to dilate (Plates XIV-XVIII; Figs. 95, 98).

The lesions in the *parenchyma* further develop either as a "dry" tuberculosis, or as a "wet" lesion, which may be due to mixed infection or may appear in kidneys from which no other than the tubercle bacillus can be recovered. In a large minority of cases, however, there is actual mixed infection. Hence the usual gross pathological types are the following:

1. *Early tuberculosis:* The striking lesion is the tuberculoma or ulcer at or near one of the upper or lower papillæ. The parenchyma back of the papilla is infiltrated and the perinephritic fascia beyond may have begun to be adherent. The pelvis may be pebbled and the fat about it adherent (Plate XIV, Fig. 93).

2. *Dry tuberculosis:* The diseased portions of the kidney are either infiltrated with tuberculosis or occupied by watery or cheesy cysts, the dilated calices. The pelvis is normal or diseased and contracted. There is considerable fibrolipoma about the kidney, pelvis and ureter (Plates XV, XVI, Fig. 94).

3. *Wet tuberculosis:* The dilated calices and the contracted pelvis are filled with pus, their walls thickened and inflamed. The perivisceral fibrolipoma is much more dense, especially about the pelvis and ureter (Plates XVII, XVIII, Figs. 95, 98, 99).

4. *Mixed types,* in which the dry and wet lesions occupy different portions of the same kidney (Figs. 96, 97).

5. *Perinephritic abscess* is so extremely rare that it seems attributable to mixed infection.

Extension of the Disease.—The tuberculosis descends the ureter by direct extension to *the bladder.* The ureter mouth becomes swollen and red, later ulcerated and retracted. Thence the infection spreads in a patchy manner over the bladder in groups of ulcerating tubercles. Mixed infection occasions tuberculous cystitis. *The prostate* becomes involved, and from it the other male genitals.

The *opposite kidney* is affected by a variety of lesions:

PLATE XIV.—EARLY RENAL TUBERCULOSIS.

The kidney is grossly normal except for the ulceration that is contracting the upper half of the pelvis and eating out the calices. The parenchyma is sclerosed about these lesions.

1. Tuberculous toxic nephritis, a parenchymatous nephritis characterized by albumin and casts in the urine and some impairment of function.

2. Hydronephrosis, which is as common in the opposite kidney, as a result of obstruction at the lower end of the ureter from the bladder tuberculosis, as it is rare in the kidney primarily involved (Fig. 99).

3. Pyelonephritis, from the same source.

4. Tuberculosis, reproducing in it the lesions in its fellow.

The Toxic Nephritis of Tuberculosis

Toxic nephritis results from the presence of grave tuberculosis within the body, whether the tuberculous lesion is in the urinary organs or not. Thus the gravely diseased sufferer from long tuberculosis exhibits toxic nephritis of various degrees. The sufferer from renal tuberculosis exhibits the same phenomenon but not the same variety of lesions. An active renal tuberculosis causes toxic nephritis both in the non-tuberculous parenchyma of the involved kidney and also in the non-tuberculous kidney. The lesions are those of parenchymatous nephritis, more or less acute. They rarely last long enough to lead to amyloid changes.

The toxic nephritis of the tuberculous kidney is not clinically appreciable but the intoxication of its non-tuberculous fellow is evinced by the discharge of albumin and casts and a restriction of renal permeability which perhaps are sufficient to raise the question as to the capacity of this non-tuberculous kidney to support life in the event of nephrectomy.

The urologist currently pays no great heed to this warning and the event seems to justify him. Considerable restriction of function, together with a high albumin concentration in the urine of the non-tuberculous kidney, is not a contra-indication to nephrectomy unless the condition has existed for years and become fixed. If the nephritis is of relatively brief duration, the successful nephrectomy will be followed by great improvement in the function of the remaining kidney. Albumin and casts will be minimized. Concentration of urea output will greatly improve. The patient will doubtless ultimately die of nephritis, yet the survival will be much longer than if nephrectomy had not been performed.

SYMPTOMS

The symptoms of renal tuberculosis usually make their first appearance between the fifteenth and thirty-fifth years.

The disease is very uncommon in childhood; indeed Oraison [2] has been able to collect only fifty-one cases of renal tuberculosis in children. Statistical reports derived from the autopsy table show a very large percentage of renal tuberculosis at a relatively advanced age. This is due to the remarkably chronic course of

[2] *J. d'urol.*, 1913, iv. No. 1.

certain cases which may run from fifteen to twenty-five years, or if actually occluded, indefinitely.

Clinical Types.—The development of the lesion in the renal parenchyma is silent. It may therefore give no symptoms or only a digestive toxemia. Four clinical types of the disease are recognized, the predominant feature of which are frequent and painful urination, hematuria, renal pain or colic and toxemia.

None of these types is exclusive. Almost every case of renal tuberculosis has frequent and painful urination as its predominating feature; almost every case has some hematuria at one time or another; renal pain is a relatively rare symptom. Toxemia is common.

The Bladder Type.—The mere presence of a tuberculous focus in the kidney causes no symptoms beyond perhaps slight fever and polyuria. When such a focus bursts into the pelvis it is likely to cause a slight brief hemorrhage; but this often passes unnoticed. The disease then spreads to the kidney pelvis and ureter, causing painful and frequent urination even before the bladder is infected. The bladder is soon invaded, however, and adds to the intensity of the symptoms.

At first the frequency of urination is definitely more marked by night than by day, and is accompanied by polyuria which is also more marked by night. Ureteral catheterization at this early stage will show a marked polyuria from the diseased kidney. The total excretion of urea may even be greater from the diseased kidney, though its phenolsulphonephthalein concentration is always less. I have seen but two exceptions to this rule. Later the diurnal frequency catches up with the nocturnal.

Pain may be felt before, during, or after micturition. But the most marked and characteristic pain is terminal, occurring at the end of micturition and continuing for some time thereafter. When intensified by lesions of the trigone, this terminal pain is associated with terminal hematuria. The urine contains pus and tubercle bacilli.

Hematuria.—The hematuria of renal tuberculosis assumes three forms which we may describe in order of their frequency:

Microscopic hematuria, containing a few red blood-cells and a trace of albumin, occurs from time to time in all cases.

Slight visible hematuria, characterized by either a smokiness in the urine or more commonly a distinctly terminal hematuria, is likely to occur as soon as the bladder has become considerably infected. Later, this often ceases.

Massive hematuria, renal hemoptysis, as it has been called, is rare; but it may dominate the scene. It occurs early, like pulmonary hemoptysis, and in the absence of other symptoms may suggest neoplasm. It is due to bleeding from an ulcerated papilla, and precisely simulates the bleeding of a kidney tumor.

Renal Pain and Colic.—Moderately severe loin pain, associated with tenderness of the kidney, occurs in perhaps half the cases. Renal colic is rare, but may occur at any time from the passage of blood-clots or shreds of tissue

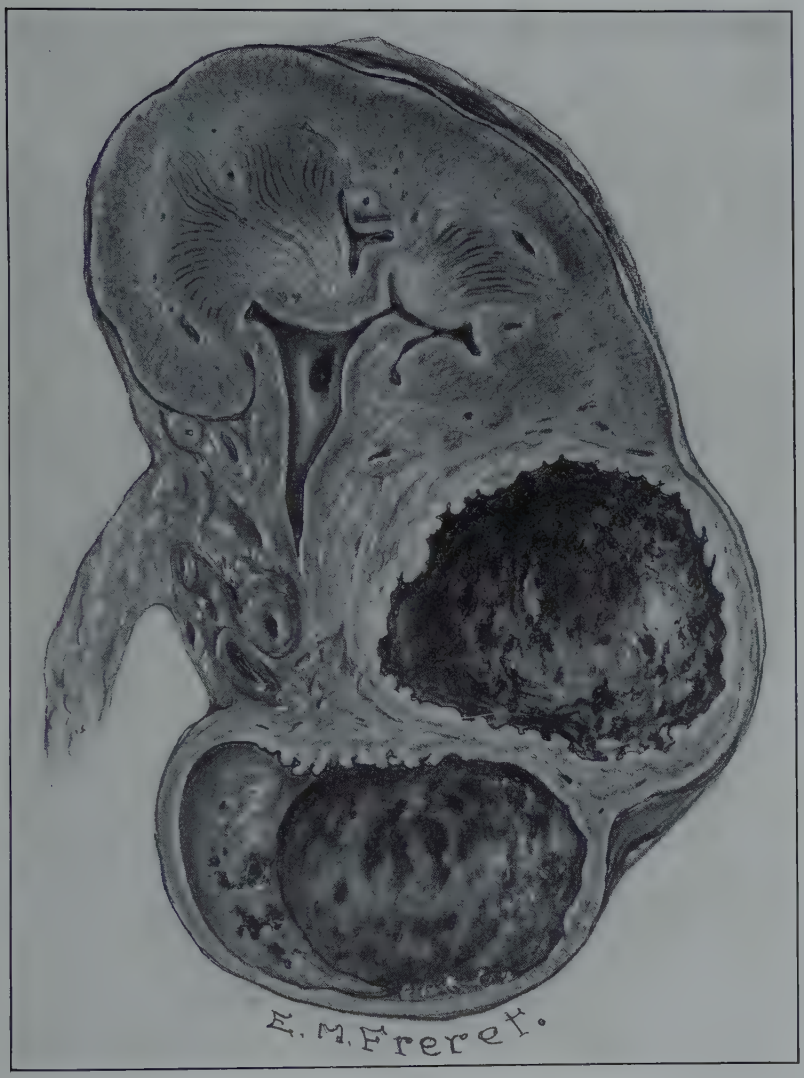

PLATE XV.—DRY TUBERCULOSIS.

The orifices of the lower calices have been shut off, the calices dilated into cysts. At the time of nephrectomy bladder symptoms had begun again after an interval of three years. Pus and tubercle bacilli. Pyelitis. Figure is the pyelogram (reversed) of this kidney.

through the narrowed ureter. Renal pain, or colic sufficiently severe to dominate the scene is unusual.

Crossed Pain.—Renal pain may occur in the healthy kidney as a result of compensatory hypertrophy of that organ. On the other hand, severe pain in the opposite loin may be due to lesions entirely independent of the renal tuberculosis. One of my cases had frightful renal colics of this type which were apparently due to tuberculous seminal vesiculitis.

Fever and Digestive Symptoms.—Slight fever and slight loss of weight doubtless occur from time to time in all cases of renal tuberculosis; but marked fever is rare and considerable loss of weight is due either to bilateral tuberculosis or to toxemia from ureteral retention. So long as retention is absent and the infection unilateral, the patient may apparently enjoy the most robust health. I shall never forget the first vision I had of a certain woman, subsequent operation upon whom proved to harbor a completely destroyed pyonephrotic tuberculous kidney. As her 250 pounds lay in a hospital bed. surrounded by her anxious family, she apparently weighed as much as all the rest of them put together.

But late in the disease the ureteral lesions are such that adequate drainage of the kidney is the exception. Considerable loss of weight, with slight fever, is the rule. Such is our interpretation of Israel's statement that he found fever in only 15 per cent of uncomplicated renal cases, but in 80 per cent of the cases complicated by bladder infection.

The dry tuberculosis may give only digestive symptoms, the familiar dry throat, anorexia and vomiting, and intestinal gas, of renal toxemia. More often such symptoms are associated with the bladder symptoms or with hematuria.

PROGRESS OF THE DISEASE

The types of clinical symptoms have been given in the order of frequency in which they are seen to-day. Yet in the actual progress of the disease the first symptom is doubtless usually hematuria, which is overlooked if mild, followed by a misinterpreted intestinal toxemia and months or years later by bladder symptoms or renal pain. For it cannot be too often emphasized that our present methods of diagnosis do not often permit us to diagnose renal tuberculosis in its incipiency, and then as a result of an early profuse hemorrhage or a chance life insurance or health examination. Consider the lesions in removed kidneys; consider the length of time that often intervenes between the date of the pulmonary and the renal lesion; yet the latter doubtless began during the course of the former. The beginnings of renal tuberculosis are silent.

Moreover, if the disease progresses as a dry type, which it usually does not, there may be intervals of years between the observed symptoms. One of my patients went six years apparently perfectly well between hematurias. Indeed, exceptionally a kidney becomes caseous throughout without exciting attention,

or with a history of only an undiagnosed renal colic or hematuria, and is found completely destroyed at autopsy or in the course of an examination undertaken for other reasons. I judge from my own experience that such pathological autonephrectomy occurs not more than once or twice in a hundred cases.

But the wet type predominates, and the wet type progresses in misery to death, by renal insufficiency or by sepsis. But this takes years. The expectation of life is from five to ten years from the onset of symptoms, unless the disease is checked by nephrectomy.

May one expect to save the tuberculous kidney? No. There exists no pathological specimen showing a completely healed renal tuberculosis without complete destruction of the kidney. I have known but one wet case to elude nephrectomy and have seen but three pathological nephrectomies among some two hundred cases of renal tuberculosis. Yet one of my wet cases had an interval of three years without symptoms, one of my dry cases six.

PHYSICAL SIGNS

The Urine.—Pus is practically constant in the urine in sufficient quantity to cloud it. I have failed to find it only thrice; once in a case of intermittent profuse hematuria, due to a small papillary ulceration, the other times in dry cases.

Albumin is equally constant; usually a trace. The presence of any appreciable percentage of albumin means toxic nephritis of the opposite kidney, and is accompanied by casts. In the absence of this toxic nephritis casts are not likely to be found.

Blood is commonly present in microscopic quantity, and fully half the cases give a history of gross hematuria.

A striking feature of *the urine is* that it is likely to be *sterile on ordinary culture-media,* if drawn from the bladder, *even though definitely purulent.* Such a sterile purulent urine is likely to be caused only by the tubercle bacillus or the gonococcus. Mixed infection is, however, present in a large minority of cases.

The urine is acid unless rendered alkaline by mixed infection.

Tubercle bacilli are to be found by smear or inoculation in almost all cases, except the old cases with much pus and mixed infection.

Urography of the tuberculous kidney discloses irregular dilatations of the ureter, contraction of the pelvis and deformities of the calices varying from the ragged exulceration or obliteration of one or more calices to the series of dilated calices resulting from back pressure and ulceration (Figs. 93-98).

The Loins.—The tuberculous kidney is usually small and palpable only if surrounded by considerable fibrolipoma. It may then be tender.

The opposite kidney may be enlarged by compensatory hypertrophy.

The ureter and kidney pelvis may be tender.

Tuberculous Lesions Elsewhere in the Body.—At the time of the first examination the bladder will be found infected in about 90 per cent of cases,

the opposite kidney in from 10 to 20 per cent. Slight prostatic infection doubtless occurs early in many men, but is usually overlooked. The infection reaches the epididymis in only a small percentage of cases.

Radiographic evidence of tuberculosis in the lungs is usually obtainable, though the clinical history is often silent on this point. Bone and gland tuberculosis are rare complications. It has been noted that a singularly large proportion of patients with genito-urinary tuberculosis die of tuberculous meningitis.

DIAGNOSIS

It is impossible to make a full diagnosis of renal tuberculosis without the ureter catheter. The diagnosis must cover the following points:

(1) The presence of urinary tuberculosis; (2) the origin of this tuberculosis in the kidney or in the prostate; (3) if in the kidney, which kidney is involved; (4) if one kidney is involved, what is the condition of its fellow; (5) are there active lesions of tuberculosis elsewhere?

The suspicion of renal tuberculosis is aroused whenever there is spontaneous bladder irritation, prolonged pyuria, or bleeding great or small in a relatively young person not yet fifty years of age. This suspicion is strengthened if the urine is acid, free from bacteria, yet purulent, and contains a trace of albumin, and microscopic or macroscopic blood. If the tubercle bacillus, which is described below, is found in the urine, the existence of tuberculosis somewhere in the urinary organs is proven. The palpably large or tender kidney may be tuberculous, or it may be the hypertrophied or hydronephrotic opposite kidney. The tuberculous kidney is usually small. Such are the hints—the proofs follow:

The Tubercle Bacillus.—In order to minimize contamination, especially with the acid-fast smegma bacillus, the urine should be drawn by catheter from the bladder or the ureters. Bladder contamination with smegma bacilli is said not to be possible, yet I have twice been temporarily misled by the report of acid-fast bacilli morphologically resembling the tubercle bacillus obtained from bladder urine, and reported by a laboratory of good repute.

In early and active cases the tubercle bacilli are usually found readily and in large numbers. But in all cases it may be difficult to identify them both on account of their scarcity and on account of mixed infection.

Jeck and Munch[3] have compared the results obtained by the methods of Crabtree, Kraus and Fleming (gasoline), Petroff, Jones, simple sedimentation and simple centrifugalization. They conclude that the greatest number of tubercle bacilli are found in sediment thrown down by simple centrifugalization if this is properly performed, as follows:

The specimen of urine is centrifugalized for fifteen minutes at 2,300 revolutions and stained by the familiar Ziehl-Neelson method. In as much as the

[3] *J. Urol.*, 1927, xviii, 607.

stain is not permanent the specimens should be examined as soon as possible after staining. This simple method suffices for most cases.

The specimen of urine is centrifugalized for fifteen minutes at 2,300 revolutions. The centrifuge tube is then inverted and held upside down for about three seconds. It is then turned right side up. Urine will collect in the bottom of the tube above the sediment to the extent of one or two drops. With a capillary pipette equipped with a rubber bulb the sediment is drawn up and then expelled into the tube. This is repeated several times. A thin emulsion is the result. Enough of this emulsion is then placed on a slide to make an area of about 1.5 cm. in diameter and at least twice as thick as the average platinum loop smear. The smears are stained for three minutes with carbol fuchsin, heated until steam arises, and decolorized with 5 per cent sulphuric acid, rinsed with 95 per cent alcohol and finally water.

Smears that contain no pus do not adhere to the slide. This difficulty may be overcome by first placing upon the slide a thin film of saliva. Pus smears too thick for proper decolorization are placed in 5 per cent acid HCl alcohol, dried in the flame and stained. The mechanical stage is employed and four minutes allotted to the examination of each slide.

If bacilli are found and there is doubt as to their identity, Cooper's method of identification is employed. A suspension of tubercle bacilli is made from a culture of these bacilli ground in a mortar and mixed with equal parts of acetone and normal saline solution. One part of this suspension is mixed with 600 parts of the patient's urine, centrifugalized and stained in the same manner on one end of a slide for comparison with the similarly prepared "unknown" smear at the other end.

Were it not for the delay involved, the guinea-pig injection would be the test of choice; but two months is a long time to wait for a diagnosis, and though this period may be shortened by various devices, such as injecting the urine subcutaneously in the thigh of the pig and bruising its inguinal glands, these devices are not regarded as entirely trustworthy by all bacteriologists. Indeed, even the guinea-pig may err.

I have rarely used guinea-pig inoculation. Yet I have seen one case of elusive ulcer from whose urine Schlagintweit had obtained a positive guinea-pig inoculation, and one of movable kidney with normal urine and positive pig. Operation proved her free from tuberculosis.

Indeed, all signs sometimes fail. One of my patients, a middle-aged woman, showed a typical clinical picture of tuberculosis; *i.e.*, frequent and painful urination, bladder ulcers, no generalized cystitis, right pyonephrosis, left kidney normal. The right ureter could not be catheterized, so no urogram could be obtained. Biopsy was done twice. The first specimen was reported papilloma, the second simple inflammation. The diagnosis of tuberculosis, based on the clinical picture, was proven correct by nephrectomy.

Tubercle Bacilli without Pus.—The presence of acid-fast bacilli in the urine without pus does not establish the diagnosis of tuberculosis unless fortified by

PLATE XVI.—DRY TUBERCULOSIS. PATHOLOGICAL NEPHRECTOMY.

Pelvis occluded. Calices dilated with caseous matter. But bladder symptoms called for nephrectomy.

urogram showing the typical urogram, a contracted renal pelvis and obliteration or dilatation of calices.

Tuberculosis of one kidney and bacilli without pus from its fellow do not prove the latter tuberculous. The probability favors bilateral infection but the bacilli may have ascended the normal ureter by reflux.

Cystoscopy.—The alert expert will not fall into the error of considering every patchy or ulcerative cystitis tuberculous, nor will he believe a kidney tuberculous because its ureter mouth is inflamed—since the kidney above may be normal—or ulcerated, deformed or retracted—for the kidney above may be the seat of non-tuberculous inflammation. There is nothing absolutely characteristic about the appearance of tuberculous cystitis. Indeed, the diagnosis of renal tuberculosis must occasionally be made even though the bladder shows no lesion. The case is likely to prove one of dry tuberculosis.

Yet the experienced cystoscopist will habitually find confirmation of the diagnosis of tuberculosis by cystoscopy. If the bladder symptoms are slight or nil, the ureter mouth on the affected side almost always is surrounded by a rather sharply delimited irregular inflammation, red, nodular, perhaps ulcerated and with similar discrete lesions in the vicinity. The more advanced bladder lesions may be confused by a mixed infection, in which case the whole surface of the bladder is intensely inflamed, its cavity contracted; while the pure tuberculosis will show an irregular distribution of patchy inflammation strewn with ulcers and groups of nodules, chiefly confined to the base of the bladder, the trigone, the fundus, the bladder neck, and especially destructive about the mouth of the ureter from the affected kidney.

But however characteristic of tuberculosis the lesions discovered in the bladder by the cystoscope may seem, these do not suffice for a diagnosis unless supported by other evidence of the disease.

Biopsy.—The excision of a piece of mucosa with the cystoscopic forceps may provide invaluable confirmatory evidence of tuberculosis when the bacilli cannot be found and the urogram is not characteristic.

The examination by urinalysis, cystoscopy and biopsy merely proves the presence or absence of tuberculosis in the urinary tract. In order to diagnose tuberculosis of the kidney ureter catheterism, renal function tests and, sometimes, urography are required.

Diagnosis of the Presence and Character of the Renal Lesion.—When *the ureters can be catheterized* the urines obtained permit the following deductions:

1. Pus from both kidneys, tubercle bacilli, both renal functions impaired. Even though the tubercle bacilli have been obtained only from the bladder urine, this combination amounts to strong presumptive evidence of bilateral renal tuberculosis. It is possible that ureteral reflux accounts for the finding of pus from one side, so that before assenting to this fateful conclusion it is well to confirm the diagnosis by one or more additional cystoscopies and by urography.

2. *Pus from one kidney,* tubercle bacilli, fixed polyuria and dilution of the urine from the kidney that delivers the pus. This is the classical picture of unilateral renal tuberculosis.

3. Pus without tubercle bacilli. The diagnosis must be confirmed by urography.

4. But if the kidney proves to be pretty well destroyed by suppuration and its fellow normal, nephrectomy may be performed without concern as to the preoperative diagnosis of tuberculosis.

When only the normal ureter can be catheterized meatoscopy and indigocarmin establish the diagnosis of impaired function of the diseased kidney and this may have to suffice for a tentative preoperative diagnosis.

When neither ureter can be catheterized indigocarmin may determine that one kidney is functioning much better than its fellow, but does not prove that the better kidney is not tuberculous. The case must be looked upon as one of bilateral tuberculosis.

Accessory evidence of renal infection, such as a lower ureter palpable per rectum (the ureter cannot be felt as well through the vagina), radiographic suggestion of calcification in ancient renal tuberculosis or the focal reaction to tuberculin, merely point with some probability to the more diseased kidney. None of them rule out tuberculosis of the opposite kidney.

I have twice seen the renal function of the diseased kidney exceed that of its normal fellow. Both were early cases of papillary ulceration, diagnosed by the pus and tubercle bacilli obtained by ureter catheter from the diseased kidney.

The ideal cystoscopic anesthesia is sacral, the ideal dye for difficult cases indigocarmin. I employ the 18 F. single catheter cystoscope, direct this immediately toward the ureter mouth, from which I expect to see the blue stream issue; if this appears, catheterize that ureter immediately without looking for anything else; if it does not appear, turn immediately to the other side and catheterize that ureter. By this combination, anesthesia and the use of a small cystoscope, a skillful manipulator can catheterize one ureter with scarcely more pain than would be involved in the introduction of a catheter. If the opposite ureter cannot be catheterized readily the cystoscope is then removed and a small rubber catheter inserted into the bladder to catch the urine from the diseased kidney.

If tubercle bacilli have not been found before ureter catheterism, they should be searched for again immediately thereafter, for the trauma of the examination often brings down a shower of them.

Urography.—The diagnosis of most cases of renal tuberculosis is complete without urography. The radiogram we need, to outline the size and position of the two kidneys, to detect perinephritic exudates of any considerable size and to outline the course of the ureters in which visible catheters have been placed. Yet it is interesting to study the gross pathology of the lesion by urography. It is quite harmless, for tuberculous lesions are not characterized by ureteral retention—except of the "opposite" ureter (Fig. 99)—and it occasionally certi-

FIG. 93.—UROGRAM OF EARLY RENAL TUBERCULOSIS.

Kidney normal except for an ulcer of a papilla lying over the twelfth rib. The injected fluid has infiltrated the parenchyma at this point. No deformity of other calices, pelvis or ureter.

FIG. 94.—UROGRAM OF KIDNEY SHOWN IN PLATE XV.

The injected fluid shows clubbing of all the calices. The lower pole of the kidney very definitely enlarged. No abnormalities are to be noted in the pelvis or the ureter.

FIG. 95.—UROGRAM OF EARLY WET TUBERCULOSIS.

The pyelographic fluid demonstrates exulceration of the lower calices. There is clubbing of the upper calices. There is some contraction of the kidney pelvis. No changes are seen in the ureter.

TUBERCULOSIS.

FIG. 96.—UROGRAM OF MIXED WET AND DRY
Upper calices closed (cheesy). Lower calices clubbed. Lower ureter irregularly dilated.

FIG. 97.—UROGRAM OF MIXED TUBERCULOSIS.

The pyelographic fluid does not enter the upper calices, demonstrating a closed type. The lower calices show clubbing. This represents a more advanced type than that shown in Fig. 96.

FIG. 98.—UROGRAM OF LATE WET TUBERCULOSIS.

Calices exulcerated, their necks contracted. Pelvis contracted. Ureter irregularly dilated.

FIG. 99.—WET TUBERCULOSIS.

The injected fluid demonstrates a pyonephrotic upper pole. The lighter areas represent the opaque fluid diluted with the inflammatory exudate and products of secretion. The pelvis is markedly contracted. The ureter is irregularly dilated and strictured. The partially filled bladder shows the broken line of intense cystitis.

fies the characteristic urogram by bringing down a shower of tubercle bacilli where none had been found before.

The characteristic urogram (Fig. 99) shows ulceration (Figs. 93, 95, 97, 98) of the calices, narrowing (Figs. 95, 98) or occlusion (Figs. 94, 96, 97) of the calical neck, clubbing of calices (Figs. 94, 95) contraction of the pelvis (Figs. 94, 95, 98, 99), irregular dilatation of the ureter (Figs. 96, 98, 99). When pathological nephrectomy has occurred, the ureter comes to an end where it meets the pelvis, which is occluded.

TREATMENT

Wildbolz [4] records his own conversion from medical to surgical treatment in convincing fashion. He cites 78 cases who three years after nephrectomy were

[4] *Cor.-Bl. f. schweitz, Aerste,* 1912, xli, 1265.

PLATE XVII.—WET TUBERCULOSIS.

Pelvis contracted. Calices exulcerated. Parenchyma almost destroyed. Fibrolipomatous perinephritis.

divided as follows: 59 per cent alive and cured, 21 per cent alive but tuberculous, 20 per cent dead. To compare with these, he collected 316 cases under observation at various sanatoria in Switzerland; 70 per cent of these had died within two years, and of the 98 survivors, 68 still suffered from urinary tuberculosis, while only 30 had been relieved of their symptoms. In 16 of these the clinical cure had persisted for over five years, but after years of apparent cure sudden breakdown and death were known to have occurred.

The classical contribution on nephrectomy for tuberculosis is that of Israel. He collected 1,023 nephrectomies with a mortality of 13 per cent in the first six months, and as many more later, half of the later mortality occurring in the period between the first six months and the end of the second year, and due chiefly to pulmonary tuberculosis, renal disease, and acute miliary tuberculosis.

The mortality from nephrectomy for renal tuberculosis is singularly low; about 3 per cent. I performed sixty-five nephrectomies for tuberculosis with 2 deaths before the patients left the hospital, and three more during the first six months thereafter.

After Treatment.—The after treatment must cover the patient's general condition, the persisting tuberculous cystitis and the loin sinus.

Nephrectomy is only the foundation of a cure. With it the cure begins, but this will not proceed unless the nephrectomy is followed by an intelligent course of antituberculosis hygiene—a compound of fresh air and overfeeding. This course may be profitably continued for at least a year, even in the most favorable cases.

The rules for the treatment of tuberculous cystitis—if this continues to annoy the patient—are laid down in the next chapter.

A loin sinus persists for at least two or three months after at least 20 per cent of nephrectomies for tuberculosis. Its healing may be hastened by cutting down granulations and use of the Beer cup. Exceptionally the whole wound will break down and become tuberculous; in this event no complete healing may be expected within one or two years. I have known such a wound to remain open for three years, and to heal at the end of that time. Carrell treatment and secondary suture may greatly hasten healing.

Contra-Indications to Nephrectomy.—The contra-indications may be found in the opposite kidney or in other organs. Of the general contra-indications to nephrectomy we need only mention active tuberculosis elsewhere in the body, and myocarditis. I have never been deterred from performing nephrectomy by the fact that the patient's lungs showed signs of apparently healed tuberculosis. Indeed I have performed nephrectomy successfully under local or spinal anesthesia in the face of a rather active pulmonary tuberculosis. In one case, however, my medical counsel declared the patient's lungs quiescent; I removed a tuberculous kidney, and the patient died a few weeks later of his pulmonary disease. In another case, I braved a mild pulmonary lesion and the patient died five months later.

The condition of the patient's circulation is of the utmost importance. A

rapid pulse before operation suggests the possibility of myocarditis, and the propriety of a preliminary week in bed on digitalis. I lost one patient on the third day afer operation through myocarditis, and have nearly lost several others. Israel regards this as a frequent cause of postoperative death.

The condition of the opposite kidney is also important. It may be congenitally deficient, otherwise diseased, the seat of tuberculous nephritis or the seat of active tuberculosis. I have never known tuberculous nephritis to be a valid contra-indication to operation.

Tuberculosis of the opposite kidney was for a long time considered a contra-indication to nephrectomy. This it certainly is not. If there is no great difference between the functional capacity of the two kidneys there is quite obviously no reason to remove either one of them. But if one is gravely infected, the other only slightly involved, the gravely infected kidney should be removed. I have had the happiest results from following this course of action; although one of my immediate deaths was the result of an attempt to help the patient by removing a kidney which after all was not much more diseased than its fellow.

But fully half of the cases of bilateral tuberculosis with grave unilateral involvement will not only survive, but will be greatly improved by operation. They may grow fatter than they had been before operation, and may consider themselves all but cured. Their death, when it does come, is likely to come quickly, and as a result of total destruction of the renal parenchyma.

Thus one patient of mine wrote me a letter, thanking me for the two years of good health he had enjoyed after taking an equal length of time to recover from his operation; but this man died of renal insufficiency four months later. Another case, one of renal tuberculosis for eleven years before operation, survived the operation four years. At the end of the third year, she weighed more than she ever had in her life, and was all but well. A year later she died very peacefully of renal insufficiency and pulmonary tuberculosis.

To sum up, the contra-indications to nephrectomy for tuberculosis are:

1. Any general condition contra-indicating a major operation.

2. Active tuberculosis elsewhere in the body such as to contra-indicate a major operation. This includes almost all cases of active pulmonary tuberculosis.

3. Tuberculosis of the opposite kidney so far advanced as to impair its phenolsulphonephthalein elimination below 30 per cent, per half hour, after intravenous injection.

4. Any other lesion, congenital or acquired, markedly reducing the function of the opposite kidney.

5. Marked tuberculous nephritis of the opposite kidney or tuberculous myocarditis sufficient to make the pulse persistently rapid are warning signs but not contra-indications to operation.

PLATE XVIII.—WET TUBERCULOSIS.

Kidney and perineal fibrolipoma had to be removed in one indistinguishable mass. Typical thickened ureter.

CHAPTER XXXI

TUBERCULOSIS OF THE BLADDER; TUBERCULOSIS OF THE PROSTATE AND SEMINAL VESICLES

TUBERCULOSIS OF THE BLADDER

Etiology

Tuberculosis of the bladder is almost always secondary to lesions in the kidney or in the prostate. It may be secondary to adjacent tuberculosis in other organs. But this is most exceptional. Thus Violer and Chalier [1] report three cases of rupture of tuberculous adnexa into the bladder. At least eight out of ten cases of bladder tuberculosis are secondary to kidney lesions.

Pathology

Distribution of Lesions.—The lesions of vesical tuberculosis begin about the ureter if the disease descends from the kidney; about the bladder neck if the invasion is from the prostate; but when the case is first cystoscoped, there is often a general distribution of the lesions about the trigone, which forbids complete diagnosis from cystoscopy alone, without the information derived from ureter catheterization.

If there is mixed infection, the whole bladder may be inflamed. If not, even though the greater part of the organ is inflamed, there are usually regions in which the normal mucous membrane may be seen at some parts of the vault of the bladder.

The tubercles appear as minute raised areas, the size of a pinhead, surrounded by an area of congestion. They are usually grouped together over irregular areas of the bladder wall, while between them the mucous membrane is red, swollen, and velvety. Thus a diffuse vesical tuberculosis gives the whole mucous membrane a velvety appearance. Although the tubercles may be seen, and sometimes even felt, through the unbroken epithelium, the initial deposit occurs, as Coplin has remarked, not in the epithelium, but in the subepithelial connective tissue.

The tuberculous ulcer "is singularly round and discoid. . . . Even the confluent ulcers rapidly lose the isthmus which at one time partly separated them and quickly assume a roundish outline. The floor of the ulcer is shaggy, of a dirty yellowish color. It is uneven in contour. . . . Commonly the ulcer does not

[1] *Rev. de gynec.*, 1909, xiii, No. 1.

become larger than 1 or 2 cm., or about the size of a 5-cent piece. The floor of the ulcer is the submucosa containing considerable embryonic tissue. In some instances and at a few points in any ulcer the muscular wall may be exposed. . . . I think extension into the muscular wall must be rather infrequent. . . . The edges are elevated and slightly undermined . . . hard to the touch" (Coplin).

The above description, written from the point of view of the pathologist, is entirely in accord with the cystoscopic findings. I have never known perforation of the bladder to occur spontaneously; but I have twice known perforation to follow cystoscopy. The great irritability of the bladder—its characteristic inability to retain more than a few ounces—is due at first to the great sensitiveness of the tuberculous lesions, later to an actual infiltration and contracture of the muscular walls.

Individual lesions may heal while others progress. The removal of the tuberculous kidney is usually followed by the subsidence of the tuberculous bladder lesions in a few months if they are recent; in a few years if ancient or fed by tuberculous prostatitis or stricture.

Direct extension of the inflammation to the posterior urethra is common. Extension to the anterior urethra is rare. Urethral stricture and periurethral abscess are rare complications.

Surprising as it may seem, the ulceration of the bladder succeeding nephrectomy for tuberculosis may not only be a mixed infection, the secondary infection may actually predominate. In this event the cystoscopic picture is rather that of elusive ulcer than that of tuberculosis.

Symptoms

The symptoms of tuberculosis of the bladder, frequent and painful urination and hematuria, complete or terminal, and its urinary changes form so essential a part of renal tuberculosis that they have been described in the preceding chapter.

Among the other symptoms due to tuberculous cystitis a partial incontinence of urine from spasm or from ulceration of the neck of the bladder is notable. Stricture of the deep urethra may cause retention of urine. The symptoms of involvement of the other genito-urinary organs are sooner or later important, hence the special necessity of a follow-up.

Diagnosis

The diagnosis has a threefold object; viz., to disclose tuberculous lesions elsewhere in the body, to determine the source, whether kidney, prostate, or fallopian tube, of the bladder tuberculosis, and to estimate the extension of the disease in the genital and urinary tract.

The state of the renal function and the existence of urethral stricture or of

prostatic sclerosis sufficient to cause slight retention of urine are of great importance in estimating the prognosis. For so long as there is no retention of urine and the symptoms are not sufficiently severe to wear out the patient's strength, he may live for many years.

If the bladder tuberculosis is sufficiently severe to merit local treatment, cystoscopy is required to determine the distribution and severity of symptoms, to distinguish tuberculous ulceration from tuberculous cystitis, to permit the diagnosis of renal tuberculosis and of prostatic sclerosis.

Caudal anesthesia, indigocarmin and the small cystoscope form the basis of a successful cystoscopy.

Estimation of the bladder capacity measures the progress of treatment less well than do the subjective symptoms.

Treatment

The first step in the treatment of bladder tuberculosis is the discovery and removal of the tuberculous kidney. This immediately reduces the amount of urine passing through the bladder by more than half, thus relieving the bladder irritation and encouraging the patient. But the immediate improvement in frequency of urination is usually of short duration. Within a week or two it may be as bad as ever. Hence it is wise to warn the patient beforehand not to expect immediate relief from nephrectomy.

It is also wise to let an interval of from two to three months elapse before attempting any local treatment of bladder tuberculosis. During this period he regains the strength and weight lost while in hospital, throws off the effect of the toxic absorption from the tuberculous kidney and gives the bladder lesions a chance to heal as much as they will. Indeed, great spontaneous remission in the bladder symptoms may occur many months after nephrectomy and, in the hope of this, local treatment should be postponed as long as possible.

During this period of waiting the patient avoids alcohol and condiments, lives on a high caloric diet and is treated by actinic rays. He may also find that sandalwood oil or bicarbonate of soda relieves his symptoms somewhat. Sitz baths may help.

If the bladder symptoms remain or become unbearable, local treatment is begun.

Local Treatment.—Before beginning local treatment the patient is cystoscoped to determine whether cystitis or ulceration predominates and to estimate the relation of prostatic sclerosis or stricture of the ureter of the remaining kidney to the symptoms. This cystoscopy is performed under caudal anesthesia and after the examination the first treatment is given.

For tuberculous cystitis, irrigate the bladder repeatedly through a small rubber catheter with 5 per cent carbolic acid until the fluid no longer returns smoky.

For ulcers apply cauterization to each. If the ulcers are large, I prefer

chemical cauterization through a straight tube with 20 per cent silver nitrate or 50 per cent liquor hydrargyri nitratis. If small, fulguration with high frequency current.

Treatments should not be repeated more often than once in two or three weeks.

As the symptoms improve milder treatments may help, such as the instillation of small quantities of gomenol, 5 per cent iodoform in olive oil, or 10 per cent argyrol, or 1 : 20,000 bichlorid of mercury several times a week.

The sclerosis of the bladder neck is the most important complication of tuberculosis of the bladder. This is attested by the fact that women suffer far less from bladder tuberculosis than men and are far more likely to recover spontaneously after nephrectomy. Now, sclerosis of the bladder neck obstructs the outflow of urine quite as do the inflammatory lesions of the ureter, by spasm or by stricture. If spasm predominates, the mere passage of the cystoscope may relieve the symptoms to an extraordinary degree. I have known a retention of 200 c.c. in a tuberculous bladder to be relieved by the single passage of a cystoscope.

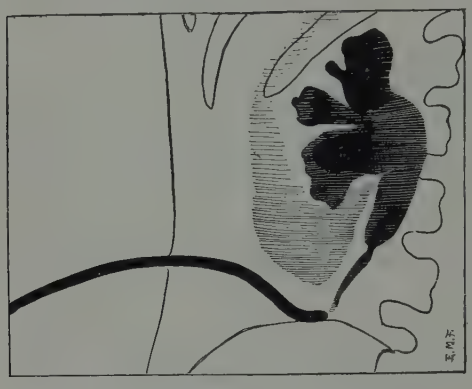

FIG. 100.—HYDRONEPHROSIS; CUTANEOUS URETEROSTOMY.

Left nephrectomy three years before. Bladder uncontrollable. Tbc. rib and epididymis. Right ureterostomy. Acid-fast bacilli from ureter. Ribs scraped. Epididymotomy. Condition excellent a year later.

If the stricture predominates, one may temporize by antispasmodic decompression and daily injections of argyrol or gomenol, and if this treatment is well borne it may even reduce the symptoms permanently.

But prostatic sclerosis may require operation.

Operative Treatment.—Prostatic sclerosis may be attacked by the Caulk or Collings electrocautery. I have twice relieved the retention by suprapubic excision of the scar. The wounds took about three months to heal, but thereafter the patients were greatly relieved.

But if the bladder lesions fail to heal under local treatment and the organ remains contracted and the patient is worn out with incessant strangury, the bladder must be put out of commission by cutaneous ureterostomy. This operation has given Marion admirable results. I have performed it three times. Once it failed to improve the condition of a bilateral case, the other two are doing well; one after five years and one after one year (Fig. 100).

The bladder has to empty itself of a drop or two of pus, at first once or twice a day, later once or twice a week.

Cystostomy does not relieve the symptoms. Pyelotomy is mechanically entirely unsatisfactory.

ULCER OF THE BLADDER

Traumatic ulcer of the bladder need not detain us. The so-called simple ulcer has already been described. Carcinomatous ulcer is carcinoma.

Syphilitic Ulcers.—Muscharinski [2] has collected the data of nine cases of syphilis of the bladder diagnosed at autopsy, six cases diagnosed by the success of treatment, and nineteen cases diagnosed by cystoscopy. The array is a formidable one, but the documents are not particularly convincing. The lesions described are papular, ulcerative, and neoplastic in type. They cause pyuria, frequency of urination, hematuria, and retention of urine. That syphilis of the bladder may exist cannot be denied, but it must be very rare. I have personally encountered but one case in which a colleague saw a syphilitic ulcer of the bladder, and cured it by injections of salicylate of mercury; thereby checking the hemorrhage which was the patient's only symptom. But the hemorrhage returned after a few months, and this time a nephrectomy for carcinoma was required to stop it!

TUBERCULOSIS OF THE PROSTATE

Tuberculosis of the prostate is the central point, as it were, of genito-urinary tuberculosis. Whether or not the prostate is the site of the original lesion of genital tuberculosis, it is through the prostate that tuberculosis of the urinary tract reaches the genitals, and vice versa, and it is through tuberculosis of the prostate that the inflammation crosses from one testicle to the other.

Yet tuberculosis of the prostate does not exist alone. Clinically it is always accompanied by tuberculosis of the seminal vesicle. Indeed it is quite possible that the vesicle is first infected. Moreover, the tuberculosis of these internal genital organs is in its early stages quite symptomless, in contrast to the severe bladder irritability that accompanies established prostatic tuberculosis as we see it in the clinic. Hence prostatic tuberculosis is very rarely diagnosed as an isolated lesion. I have seen but two cases, one whose prostate was removed under the diagnosis of carcinoma, the other an individual whose progress I have followed for seven years. At first he had a mild prostatitis accompanied by a disproportionately severe irritation of the bladder. So slight was his lesion and so badly did it react to local treatment that an excellent urologist attributed his symptoms to neurasthenia. But his urine showed acid-fast bacilla on every examination and guinea-pig inoculation was positive. After a few months the bacilli disappeared from the urine, but the prostatitis continued, as did the symptoms, though these grew milder and he found some relief from the gentle passage of a small sound. At the end of three years the prostate felt a little indurated, about as it did in the first place, the vesicles seemed normal, cystoscopy was entirely negative and the urine obtained by ureter catheter was free from pus and bacteria, the renal function unimpaired, the epididymes not infected.

[2] *Ztschr. f. Urol.*, 1912, vi, 5.

At the end of the fourth year of his disease his symptoms again became severe so, after satisfying myself by repeated ureter catheterization that the kidneys were not infected, I opened the bladder suprapubically and took a bite out of the sclerotic bladder neck. This was reported tuberculous, the wound took three months to heal, since which time he has been in much better condition and now, three years after the operation, considers himself well, though he stays in the country for six months in the year and still has some pus in the urine in which, since operation, no tubercle bacilli have been found.

The Caulk and Collings operations have been employed to relieve retention due to tuberculous prostatic sclerosis.

Pathology

Tuberculization always begins just beneath the glandular epithelium. It goes through the ordinary stages of caseation, abscess formation, and fistulization, or it may terminate by cicatrization.

It invades every part of the gland, including the posterior lobe.

When abscess forms, it usually bursts into the urethra. I have known a number to open posteriorly, into the perineum. The tuberculosis spreads to the posterior urethra and bladder.

Symptoms

The disease begins in one of five ways:

1. It is secondary to a chronic posterior urethritis, assuming its specific characteristics imperceptibly, and patient and surgeon are often unaware of the change until rudely aroused by some of the typical manifestations of tubercle in bladder or epididymis.

2. It is apparently spontaneous. The patient comes complaining of gleet or dysuria for which he fails to account.

3. It is a minor feature of an epididymal infection. The patient complains of the enlarged testicle, and is not aware of the shreds and pus in his urine that testify to the prostatic inflammation.

4. Perineal abscess may be the first symptom of which the patient complains.

5. Less frequently a spontaneous hematuria or a urethrorrhagia is the first sign of the disease.

The prostate may be tuberculous for many years and yet give no symptom. When symptoms arise they are due to ulceration of the posterior urethra and bladder neck and are precisely those of tuberculous cystitis.

Diagnosis

The diagnosis of tuberculosis of the prostate is best made during life by the discovery of acid-fast bacilli pathogenic to guinea-pigs in the secretion expressed from the prostate.

Yet, in as much as we do not ordinarily attack the tuberculous prostate directly, the diagnosis is usually made quite casually. It is generally believed that all males with tuberculosis of the bladder have tuberculosis of the prostate. I believe that very nearly all patients with tuberculosis of the epididymis have tuberculosis of the prostate, yet most of these show clinically no evidence of bladder involvement.

Deep suppuration in the male perineum not caused by grave urethral stricture and not associated with the acute infiltration of urine, is almost always tuberculous and arises from the prostate, though this diagnosis is not suggested in most instances until the pathologist has reported it upon a piece of tissue removed at operation.

Treatment

Tuberculosis in the prostate is usually quite silent and yet it doubtless rarely wholly heals. Most cases therefore are not treated at all and it is proper to avoid operation if possible, though Young and Quinby have found it advantageous to remove the vesicles and as much as possible of the prostate when they perform epididymectomy for tuberculosis. This operation should be absolutely condemned until its supporters shall prove it at least innocuous by more convincing evidence than is as yet at hand. No surgery is safe upon the tuberculous individual and the complete removal of the internal genitals is no small operation. Moreover, it is founded upon the false surgical principle of attempting to remove the whole of a tuberculous infection which has been so disastrous a chapter in lymph-node surgery. And the operation does not actually remove all the tuberculous focus. A patient upon whom I witnessed a most skillful dissection of the perineum had before the operation a tuberculous fistula and five years later he had the same fistula.

But one is forced to operate when the prostate causes unbearable bladder symptoms or breaks down and discharges into the perineum. The operation for prostatic tuberculosis causing unbearable bladder symptoms should be deferred as long and as humanly possible and should be preceded by absolute evidence that sclerosis of the prostate exists and tuberculosis of the kidney does not, otherwise the surgeon will find himself vainly operating upon a tuberculous bladder.

The operation is that for prostatic sclerosis. I have felt safer to use the suprapubic approach on condition that special care is made to invert the bladder well around the suprapubic tube so as to hasten healing. Tuberculous suprapubic fistula at best takes three months to heal, as in the case cited.

Curiously enough, the outlook for operation upon abscess from the tuberculous prostate is excellent. Unless the patient is overwhelmed by his disease, the most desperate cases may be attacked with the confident expectation that intelligent surgery will heal them. The "rabbit warren" perineum should be excised with all the superficial scar that has defaced buttocks and perineum. The urethra should be spared if possible, yet, if it must be opened, this should be done with the same object in view, that of excising all of the scar. When this

tedious task has been accomplished, the perineum will be left with a tuberculous fistula leading to the prostate. This should be curetted and cauterized with due respect for the rectum, but with special care to open up all pockets no matter where they lead.

In the after treatment of such an operation, the only special point of importance is that all drainage material be removed as rapidly as possible and the patient be seen at least twice a week until one is satisfied that no new pockets are going to develop and after that once a week until he is healed.

The most trying case of perineal suppuration due to tuberculosis I have seen died in December, 1927, at the age of sixty-nine.

His symptoms began with a hematuria in 1890. McBurney diagnosed stone in the right kidney, operated in 1900 and found none. In 1908 when I first saw him with a terrible cystitis and grave hematuria, he had been searched thrice and cystoscoped twice in vain for stone. I found tuberculosis of the right kidney and removed this. A month later the right testicle suppurated, then the left. Two months thereafter a perineal abscess was incised and two months after that he passed gas from the urethra. I then excavated his buttocks and perineum and in spite of his continued frequency of urination managed to break him of a morphin habit. A year after operation he was still passing urine every hour at night, could work about two hours a day but could not sit down because of the perineal wound which was still open. An attempt to introduce an instrument into his bladder resulted in retention of urine and in April, 1910, within nine months of the first operation upon the perineum, I opened it a second time down to the prostate and stretched the membranous urethra and the bladder neck. I noted at that time that the prostate seemed quite destroyed by tuberculosis. His convalescence was entirely uneventful and within six months he was playing thirty-six holes of golf a day. He still had two pinhole fistulæ in the perineum in 1912, but for the fifteen years between that time and the date of his death from renal insufficiency he had considered himself a well man.

TUBERCULOSIS OF THE SEMINAL VESICLE

So silent is the course of vesicular tuberculosis that we know very little of it beyond its pathology. Whether tuberculosis of the internal male genitals begins in the prostate or in the vesicle is not clear. The exceptional autopsy report that reveals a solitary focus in one or the other organ does not help to classify the lesion. Clinically both vesicles and the prostate are involved together.

The tuberculous vesicles feel more nodular than does the tuberculous prostate. But many a case of vesicular tuberculosis cannot be distinguished by rectal touch.

The less the tuberculous vesicle is massaged the better, and surgery is out of place except for the occasional drainage of a deep perineal abscess through an incision in one or the other ischiorectal fossæ.

Doubtless heliotherapy helps.

CHAPTER XXXII

MOVABLE KIDNEY

The kidney is naturally mobile. Like the other abdominal viscera it moves with respiration and its position is influenced by the attitude of the subject. This condition is entirely normal. Such a kidney is not distinctly palpable. A movable kidney, on the other hand, is one that is subject to downward displacement to such an extent that it may be distinctly palpated by the usual methods of examination. One may distinguish mobility of the first degree, when the fingers can grasp the kidney, the second degree, when the fingers can be brought together above the organ, and the third degree, when the kidney can be depressed into the iliac fossa.

One distinguishes renal mobility from renal misplacement. The movable kidney returns at least approximately to its normal position. The misplaced kidney does not.

The actual mobility of the kidney is much better studied by radiogram than by palpation. The x-ray reveals that in the sitting or standing position many kidneys descend to the crest of the ilium, and yet the same kidneys cannot be palpated because the abdominal wall is too fat or too rigid. By palpation mobility can be distinguished in about 20 per cent of women and in about 2 per cent of men. Radiography adds perhaps 10 per cent to the former and 2 per cent to the latter figure.

Renal mobility is almost always bilateral, but in as much as the right kidney is, even in the normal position, lower than the left, palpation often detects it only on the right side and symptoms due to renal mobility are almost always on the right side.

PATHOGENESIS

To be satisfactory, a theory must explain (*a*) the predominance of movable kidney in woman, (*b*) the frequency with which it occurs on the right side, and (*c*) its importance between the ages of twenty and forty.

We shall consider:

Primary predisposing cause: Shape of the lumbar recess

Secondary predisposing causes { Pregnancy / Emaciation / Enteroptosis

Exciting causes

Abt[1] and Morris have collected cases of congenital nephroptosis. Yet the discovery of a movable kidney in a child is undoubtedly exceptional, and the occurrence of any symptoms before puberty is rarer still. With our present knowledge it is impossible to say what may be the cause of renal mobility in childhood. It has not been determined how far the factors that operate in later life are at work, and how great a part actual abnormal development plays. Coffey,[2] however, states that "a unilateral right movable kidney is almost never seen except in cases where there has been a deficient peritoneal fusion of the ascending colon and mesocolon with the parietal peritoneum in front of the kidney."

Wolkow and Delitzen showed that there is quite a wide variation in the size of the niche in the loin occupied by the kidney. The paravertebral niche, as they call it, is shallower in women than in men, shallower on the right side[3] than on the left. The feminine peculiarity appears with the broadening of the pelvis at the advent of puberty; and it is this feminine, right-sided shallowness of the bed in which the kidney normally lies that is the chief predisposing cause of nephroptosis.

Harris maintains that the chief characteristics of the body form that predispose to nephroptosis "are a marked contraction of the middle zone of the body with a diminution in the capacity of this portion of the body cavity. This diminution in the capacity of the middle zone depresses the kidney, so that the constricted outlet of the zone comes above the center of the organ, and all acts, such as coughing, straining, lifting, flexions of the body, etc., which tend to adduct the lower ribs, press on the upper pole of the kidney and crowd it still farther downward. It is the long-continued repetition, in a suitable body form, of these influences, which collectively may be called internal traumata, that gradually produces a movable kidney."

The internal traumata just mentioned, and many others, such as intermittent renal congestion during menstruation, prolapse, and inflammation of the pelvic organs, etc., may be included here; but we need discuss only four alleged causes —viz., enteroptosis, weakness of the abdominal muscular wall, pregnancy, and emaciation.

Enteroptosis is a general condition, of which nephroptosis is often one of the features. In preradiographic times the connection between the two could not be established, but radiography has shown coloptosis to be much more common than had been supposed, and nephroptosis is secondary to general enteroptosis by means of the nephrocolic ligament, a band leading from the hepatic flexure to the lower pole of the right kidney.[4]

Pregnancy introduces another dispute. Repeated pregnancies favor relaxation of the abdominal wall and enteroptosis, yet there is an absolute disagreement

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[1] *J. Am. M. Ass.*, 1901, xxxvi, 1166.
[2] *Surg., Gynec. & Obst.*, 1912, xv, 381.
[3] Chiefly because the liver fills the upper segment of the niche on this side.
[4] *Cf.* Longyear, *Nephrocoloptosis*, 1910.

in the statistics on nephroptosis. Landau, Senator, Moulin, Morris, and others maintain that movable kidney is more frequent in women who have borne children, while Küttner, Godard-Danhieux, and Lindner defend the opposite viewpoint.

Weakness of the abdominal wall, Wolkow and Delitzen insist, is a strong predisposing factor in enteroptosis and nephroptosis. The abdominal viscera are deprived of their necessary support, and therefore sag downward, carrying the kidneys with them, in case the shallowness of the paravertebral niches makes these organs liable to prolapse.

Emaciation, it is stated, causes nephroptosis by absorption of the perirenal fat. Morris has often noted the small quantity of fat that surrounds kidneys requiring nephrorrhaphy. Yet one can scarcely believe that the absorption of fat could be so sudden as to leave a space into which the kidney would sag. On the other hand, it is quite conceivable that the excursions of a movable kidney should discourage the deposition of fat within its fascial envelope.

Corsets have been alternately praised and condemned. A corset that brings pressure to bear below the kidney region will, if applied while the kidney is in place, help to retain a movable organ; while a long-waisted corset that compresses the ribs is equally likely to encourage renal mobility. The fact that Egyptians suffer from movable kidney is evidence that the corset does not deserve all the blame which has been heaped upon it. Yet it does weaken the abdominal wall and so increases the liability to nephroptosis.

Position is justly blamed by Cabot and Browne, who maintain that a drooping, flat-chested, round-shouldered attitude compresses the lower ribs and is the occasion of many cases of renal mobility.

Trauma of one sort or another is certainly the exciting cause of all cases of movable kidney. But it is equally certain that the trauma in question is usually of a mild type. Suckling mentions the influence of constant stooping. Internal traumata have been enumerated, and the influence of pregnancy and corsets have already been mentioned. Bergmann insists upon the evil effect of horseback riding.

The effect of acute trauma, from falls, kicks, and blows, is an open question. Harris absolutely denies its influence, and though many acute cases from this cause have been enumerated, in most instances the trauma has been only the cause of symptoms in an organ already movable.

Secondary Changes.—As a result of long-continued mobility the renal vessels may become considerably lengthened. They are the radii of the circle in which the kidney moves; as they lengthen mobility increases.

The ureter may become kinked and, if inflammatory adhesions fix this kink, the free outflow of urine is obstructed and hydronephrosis results.

The kidney itself may be misshapen through pressure, or inflamed or hydronephrotic.

Exceptionally gangrene of the kidney has occurred from torsion of the pedicle.

SYMPTOMS

In examining a patient, one occasionally finds a movable kidney which has never given any symptoms, and of whose existence the patient will not become aware unless the examiner announces his discovery. A second class of cases, while having movable kidneys and suffering from various symptoms, digestive, neurotic, or pelvic, have no symptoms directly referable to the kidney itself. The organ is neither tender nor enlarged. There is no history of hydronephrosis, no evidence of either urinary infection or hydronephrosis. Finally, there are other cases with symptoms directly referable to the kidney itself. Thus nephroptosis is encountered clinically under three aspects:

Nephroptosis without symptoms
Nephroptosis without symptoms directly referable to the kidney
Nephroptosis with symptoms directly referable to the kidney

The greater number of cases, commonly classed as movable kidneys, have no symptoms directly referable to the kidney, and it is the infinite variety of symptoms which such cases present, the doubtful origin of these symptoms, and the uncertainty of their cure, that has obscured the whole subject and given rise to opinions so divergent and to discussion so virulent.

The class of cases under discussion has but two common features: (1) The subjective symptoms are referable to any one of several diseases of organs other than the kidneys, and (2) one or both kidneys are movable, but present no signs, either subjective, as pain, or objective, of disease. Such patients may present nervous symptoms, digestive disorders, or painful symptoms.

It is quite impracticable to detail the various symptoms that have been attributed to renal mobility. Their name is legion. But the question that always arises is: Do the symptoms depend upon the movable kidney? One is tempted to answer with a categorical No. My father once relieved the symptoms of a psychasthenic young woman by nephropexy after the best medical talent in town had forbidden the operation. But eight years later the patient developed pain in the kidney which led her the rounds again until my father removed the kidney and thus relieved the pain. Then followed years of varied symptoms. She developed bladder and bowel symptoms and was twice reported in medical journals of the day as cured of symptoms by fantastic remedies. A somewhat wan matrimony finally relieved the profession of the obligation to listen to her story.

It has been suggested that lying down relieves the symptoms if they are actually referable to the kidney, or that relief obtained by corset proves the renal origin of the symptoms. Neither belief is quite founded, for decubitus and corset alike relieve the coloptosis as well rather more than they do the nephroptosis. Unless urography and renal function tests prove the existence of a renal lesion the source of the symptoms must be sought elsewhere.

The flatulent dyspepsia and constipation that figure so prominently among

the symptoms of nephroptosis are rarely referable to the kidney. Einhorn's opinion upon this subject deserves quotation:

"Most of the gastric and intestinal symptoms, such as pains, eructations, nausea, occasional vomiting, irregularity of the bowels, chiefly constipation, sometimes diarrhea, which are present in persons with movable kidney, occur usually independently of the latter, and require therapeutic measures appropriate to such conditions."

Once again the decision rests with the function tests and urography.

The pains most often attributed to movable kidney are: (1) Pain and tenderness in the kidney itself; (2) pain near the edge of the rectus and near the level of the umbilicus; (3) frequent and painful urination. It is characteristic that these pains should be increased by exercise, and should be more severe during the menstrual period. Any of them may be attributable to conditions other than nephroptosis.

In diagnosing the origin of pain one is on surer ground. The evidence derived from the renal function tests and urography is supported by asking the patient to recognize that distention of the kidney pelvis reproduces the pain complained of. If the kidney is tender and painful, if the tenderness is relieved by reposition of the organ, if there is renal colic, or if the tender kidney is enlarged or adherent in an abnormal position, we have direct physical evidence that the symptom is due to the nephroptosis. Even more characteristic is the intermittent hydronephrosis due to movable kidney.

Renal infection may also complicate mobility.

Lillienthal [5] has reported two cases which he interprets as torsion of the kidney.

DIAGNOSIS

Slight mobility may be detected by ballottement. As a rule, it is not difficult to distinguish a freely movable kidney from other abdominal tumors. The very mobility of the organ, the fact that it may be replaced in the loin, together with its general contour, and the sickening sensation, similar to and yet not the same as the ovarian sensation, caused by pressure upon it, are sufficiently characteristic. Tumors arising from the ovaries or uterus may be distinguished by their pelvic attachments. To distinguish a movable kidney from a distended gall-bladder, or a corset-lobe of the liver, we sometimes have to resort to urography (Figs. 27, 32, 35).

But the discovery of a movable kidney by no means completes the diagnosis. It is equally important to ascertain whether the symptoms are due to the nephroptosis or to something else. In some cases there can be no doubt that the kidney is at fault. If a hydronephrosis or a pyelonephritis is discovered, here is a pathological condition demanding treatment.

Pain is located by the patient's recognition that distention of the renal pelvis reproduces the pain of which she complains and urography reveals any changes

[5] *Am. J. Dermat.*, 1912, xvi, No. 5.

in the shape of the renal pelvis or ureter. Toxic symptoms, digestive symptoms, headache, etc., form a more difficult problem. They must not be attributed to the kidney unless the urogram shows some lesion, and even then they may be due to ureteral stricture, as suggested by a hang of the bulbous ureter bougie, and proven by relieving them by ureteral dilatation.

In this connection a new and as yet unsolved problem has arisen. It is alleged that certain renal pains are of sympathetic origin and relievable only by section of the nerves accompanying the renal pedicle, especially those surrounding the renal artery. At the 1924 meeting of the International Urological Society Legueu and others reported the relief of renal pain by this sympathectomy. Time will prove whether there actually is a class of cases without renal lesion but with renal pain that are thus relievable.

TREATMENT

The treatment of subjective symptoms due to renal mobility is palliative; surgical measures should be reserved for the treatment of kidneys showing definite pathological lesions, and for those cases that do not respond to persistent, intelligent palliative treatment.

Palliative Treatment.—The broad lines of palliative treatment are:

1. To remedy digestive and menstrual derangements
2. To correct position and avoid overfatigue
3. To improve the general vitality and combat psychasthenia by overfeeding, massage, hygiene, etc.
4. To apply an abdominal supporter

The backbone of the non-operative prevention and cure of the symptoms of nephroptosis is a course of orthopedic training in proper position. The patient must learn to stand and walk touching the clouds with the crown. "Chest out, and everything else—chin, abdomen, hips, toes—in," must be the rule. Such an attitude makes room for the solid viscera under the diaphragm and relieves many patients.

Much emphasis is placed upon the kind of belt or corset employed to support the abdomen. Edebohls has quoted the opinions of various writers upon this subject, even to that of Gurtzburg, who "administers a yeast ferment with the object of producing meteorism, and thus sustaining the prolapsed kidney." This is an extreme example of the fallacious impression that a support must be worn solely for the purposes of retaining a kidney in place, and that, this accomplished, the cure is assured. Nothing could be further from the truth. As a matter of fact, it is the patient's general condition that should be attacked primarily, the local condition only secondarily. Many a case of "movable kidney" is cured by hygiene, diet, and exercise, while the kidney remains as loose as ever. Moreover, in applying a belt or a corset the effort must be made to support all the abdominal viscera, not the kidney only. It is not conceivable

that any form of pad should hold the kidney in place, and therefore it is wiser to dispense entirely with pads and to support the abdominal contents *en masse*. For this purpose the modern straight-front corset may be employed. Some women find that this, if applied in the recumbent position, acts as an admirable supporter.

Nephropexy is the operation of fixing the prolapsed kidney in place.

The indication under which nephropexy is advised nowadays is usually nephralgia or renal colic and the operation is by no means a simple suspension of the kidney in the loin. It must be preceded by a careful and complete urological examination which reveals, as a rule, besides the nephroptosis, a slight hydronephrosis and a tendency to kink on the part of the ureter. The operation consists of a thorough exploration of the loin, freeing the ureter at least in its upper portion, decapsulating, perhaps dividing the nerves, and finally fixing the kidney, not with the intent of forcing it up under the ribs where there is probably no room for it, but in the hope of so placing it that its pelvis will drain readily.

The earlier nephropexies so frequently failed to relieve symptoms that many physicians opposed the operation on the ground that a permanent cure was never accomplished by operation; but recent statistics tell an entirely different story. Morris performed ninety-eight nephropexies with one death, a case of "cardiac thrombosis in a stout female whose kidney was incised and explored before being fixed," and only "a few" relapses. Edebohls reports 193 cases, sixty-eight bilateral, with three deaths and two known relapses. All of my own cases have been successful.

But nephropexy may be regarded from another point of view. In a very considerable proportion of cases the patients have complained of more pain after the operation than before. This may be due to one of several factors: perhaps the pain did not commence in the kidney, and therefore was not relieved by operation, but was rather intensified by the shock and disappointment; or perhaps it was due to adhesions or kinks of the ureter which were not relieved by the surgeon; or perhaps the kidney was replaced high up in the loin in a niche from which it had descended because there was not sufficient room for it.

With each advance in our understanding of ureteral obstruction, we get better and better results from nephropexy.

CHAPTER XXXIII

HYDRONEPHROSIS

Obstruction to the outflow of urine down the ureter is of two kinds: (1) Sudden complete obstruction, (2) gradual or incomplete obstruction.

Sudden complete obstruction occurs clinically under two forms, viz., by a calculus and by the surgeon's ligation. In either event the result is the same. The urine is dammed back upon the kidney, causing an acute renal congestion and a diminished secretion of urine; but even this increases the intrarenal pressure. The congestion is exchanged for atrophy after little dilatation has occurred, thus terminating the usefulness of the organ.

Gradual, incomplete, or intermittent urinary obstruction sets up a very different train of events. Some urine escapes past the obstruction, continuously or from time to time, and affords partial relief to the renal tension, while still keeping up a very considerable pressure. Thus the organ does not atrophy. It continues to excrete an amount of urine equivalent to what can pass the obstruction, while the continued high pressure within the kidney causes a gradual dilatation of its cavity. Pelvis and calices gradually dilate—and there is hydronephrosis (cystonephrosis, nephrectasis, renal distention, uronephrosis).

ETIOLOGY

The influence of infection in causing hydronephrosis is not clear. All specimens of grave chronic renal infection exhibit some slight dilatation of the renal pelvis, even though there be no appreciable obstruction. There is *a priori* reason to believe that grave chronic renal infection does not occur in the absence of all retention. Yet animal experiments have shown that infection is a predominating cause of hydronephrosis. Even the kidney whose ureter is closed by ligature becomes hydronephrotic if mildly infected, while infection of the non-stenosed ureter causes hydronephrosis.

But the usual cause of hydronephrosis is gradual, incomplete, or intermittent urinary obstruction. The obstruction may be at any point in the urethra or ureter.

Urethral Obstruction.—The common urethral obstructions are stricture and prostatism. But the former always and the latter usually damages the kidneys more by infection than by dilatation. The bladder bears the brunt of the distention, and, although the kidneys and ureters become dilated by chronic urethral obstruction (Fig. 58), this dilatation is clinically subordinate to the inflammatory features of the disease.

PLATE XIX.—HYDRONEPHROSIS DUE TO STRICTURE AT UPPER END OF URETER.

Infiltrated with pyelographic fluid (argyrol). Note the black spots of argyrol in parenchyma.

Ureteral Obstruction.—Ureteral obstruction acts differently. No distensible bladder intervenes to distribute the pressure, and infection is often entirely absent; so that the aseptic dilatation of kidney and ureter progresses rapidly and unobscured.

The ureteral obstructions are:

1. Obstruction from within by stone, tumor, or foreign body (Figs. 29, 30, 37).

2. Pressure from without by aberrant renal vessel (Fig. 101) or by pelvic growth.

3. Kinking of the ureter from nephroptosis or misplaced kidney.

4. Strictures of the ureter, especially those caused by anomalous origin of the duct or by stricture at its termination.

5. Congenital dilatation of the whole ureter with the kidney, either with or without stricture of the vesical orifice.

6. Trauma to the kidney causing true or pseudohydronephrosis.

7. Ureteral trauma, whether partial division of the duct, stripping it of its blood supply, as in the Wertheim operation, or ligature. Ligature with simple catgut leaves a permanent stricture.

PATHOLOGY

The Hydronephrotic Sac.—The tumor may consist of only a part of the kidney, whether because the kidney possesses two ureters, only one of which is blocked, or because a single calix becomes occluded by a stone. Either condition is very rare; as a rule, the sac consists of the entire kidney and its pelvis. The ureter may also be dilated.

The size of the tumor varies from that of a normal kidney to that of a child's head.

The sac wall consists of the renal pelvis and capsule. The kidney caps the tumor. The outer surface of the mass is irregularly ovoidal, the inner surface is irregular. If the hydronephrosis is small its interior consists of the dilated pelvis and calices (Fig. 100). If large, it is a great, smooth-walled cavity crossed by fibrous septa representing the remains of the columns of Bertini (Fig. 101). The sac wall may be thin, but is usually tough and fibrous. Cartilaginous nodules have been observed in it.

Renal Changes.—The changes in the kidney substance are interesting. At first the kidney is congested, the canaliculi dilated, and the cells flattened. This process soon manifests itself macroscopically by the thinning out of the kidney tissue. It is favored by compression of the parenchymal vessels (Hinman[1]). Thus the kidney becomes more and more spread out on the surface of the sac with a great portion of its secreting substance atrophied. But this is not the only change. The remaining parenchyma cells—for the kidney is never completely atrophied—undergo a compensatory hypertrophy. They grow to

[1] *J. Urol.*, 1924, xi, 435.

three or four times their normal size and their secretory capacity increases accordingly. It is for this reason that the hydronephrotic kidney should be recognized as a useful, though an impaired, organ, and should not be sacrificed unnecessarily.

FIG. 101.—HYDRONEPHROSIS FROM URETERAL COMPRESSION (AT A) BY A BRANCH OF THE RENAL VEIN.

This obstruction caused an intermittent hydronephrosis, which was permanently cured by the liberation of adhesions and nephropexy.

FIG. 102.—INFECTED HYDRONEPHROSIS. MOVABLE KIDNEY. STRICTURE AT UPPER END OF URETER.

The ureteral dilatation and kinking are due to renal mobility and ureteritis.

FIG. 103.—INFECTED HYDRONEPHROSIS.

Kink at upper end of ureter. Misleading urogram due to inadequate injection. The diagnosis should be made without urogram. See Fig. 104.

The hydronephrotic sac may be open or closed. If the ureter is merely kinked, the hydronephrosis is usually intermittent. If contractured or obstructed, the hydronephrosis is fixed or constant, and the orifice of the sac may finally become absolutely sealed.

The Fluid.—The normal kidney pelvis will hold from 2 to 8 c.c. A pelvis that will hold more is dilated. One case is reported (Glass) containing 30 gallons.

The quality of the fluid varies. A large ancient fixed hydronephrosis usually contains a simple solution of sodium chlorid, though it may contain traces of urea, albumin, urinary crystals, epithelial cells, and leukocytes, and less often blood or cholesterin.

There may be a pyelonephritis, with infection of the contents of the sac

(infected hydronephrosis). This infection hastens the destruction of renal parenchyma.

Physiology.[2]—The hydronephrotic kidney secretes a urine less rich in solids than that of a normal organ; but Guyon and Albarran [3] have shown that even the kidney whose ureter has been occluded for a great while will begin to secrete when the obstruction is removed. Urea appears in the secretion, though it may have been entirely absent from the fluid in the sac; while the quantity of fluid secreted by the diseased organ is excessive as soon as the pressure of retention is relieved. In one case (infected) in which the renal tissue was so compressed that it was only 2 or 3 mm. thick, the kidney excreted a liter a day after the pressure had been removed.

The kidney whose outlet has not been entirely closed acts in a similar manner. While an excessive quantity of urine may be excreted by the diseased organ, it is poor in urea and salts. It usually excretes one-quarter to one-third of the total urea. While the total excretion of urea may vary widely from day to day, this variation takes place almost entirely in the sound kidney, the diseased organ excreting an approximately constant amount.

After the retention has been relieved the dilated renal pelvis never resumes its normal shape and though the recuperative capacity of the parenchyma is unbelievably great, except in so far as it has been permanently impaired by infection, this never returns to the supernormal that is actually normal. Hydronephrosis is often due to stone and secondary stone is a common complication of pyonephrosis, but hydronephrotic kidneys do not produce primary stones because they have permanently lost the power of superconcentration.

FIG. 104.—SAME CASE AS IN FIG. 103.

Hydronephrosis diagnosed by ureter catheter which revealed gravely impaired function, infection, retention. Diagnosis proven by urogram and promptly relieved by nephrectomy. Note dilution of fluid by urine in dilated kidney pelvis.

Most hydronephroses do not attain a great size or themselves prove fatal

[2] *Hinman, Tr. Am. Ass. Genito-Urin. Surg.*, 1922, xv, 241.

[3] *Guyon's Annales*, 1897, xv, 1200.

except by diminishing the patient's resistance to intermittent disease. But they are liable to the accidents of grave infection, which changes the hydronephrosis to pyonephrosis, or to spontaneous or traumatic rupture. The rupture usually takes place into the perinephritic space, rarely into the peritoneum (Babitski [4]).

SYMPTOMS

Hydronephrosis, like so many other obstructive urinary phenomena, shows no constancy whatever in the relation of symptom to pathological condition. The smaller distentions are often the most painful. Many kidneys found hydronephrotic postmortem give no symptoms during life.

The symptoms of hydronephrosis are those of renal retention; viz., painful symptoms, in the loin from distention of the parenchyma, at the outer edge of the rectus on a level with the umbilicus from distention of the pelvis, constant and aching or intermittent in the form of renal colic; toxic digestive symptoms; and symptoms of infection.

The one misleading symptom is hematuria. This is not uncommon at the onset of an acute retention or during its course. Though usually slight and lasting only a day or so, it may be profuse or prolonged. Like the initial hematuria of acute pyelitis it may lead to the unwarranted suspicion of stone.

DIAGNOSIS

Hydronephrosis is after all only the evidence of obstruction to the outflow of urine from the kidney. Distention of the kidney pelvis, like distention of the bladder, is not a disease, but the sign of retention. The diagnosis bears much more upon this retention than upon the hydronephrosis itself.

It is futile to quarrel, as clinicians used to do, over the definition of how much urine must be retained in the kidney pelvis to constitute a hydronephrosis. The disease is the retention. If this is relieved before the kidney function is utterly destroyed, the persistent dilatation of the kidney pelvis and ureter has no clinical interest.

The gross diagnosis is often made from the clinical history, the urinalysis and the examination of the loin, bimanual for small, bilateral for large kidneys.

The accurate diagnosis of the cause of obstruction and the degree of retention requires a complete examination by ureter catheter and urography. But *urography should not be employed if the sufficient diagnosis can be made without it,* for some of the fluid is likely to be retained in the kidney pelvis and, even though this be carefully drained and washed out, the trauma of examination is likely to increase the ureteral obstruction to such a degree as to bring on acute retention and acute infection simultaneously. One sees quite a few patients whose pyonephrosis or renal stone dates from indiscreet urologic examination, and occasionally a sudden death by acute sepsis arising from this

[4] *Arch. f. klin. Chir.,* 1912, xcvii, No. 4.

cause. In order to save life one must be prepared to operate upon such patients immediately. Hence they should be kept under surveillance after examination, and the urography omitted if the dilatation of the urinary channel is manifest from the gush of urine after the catheter has passed a certain point. The most accurate diagnosis requires no more than a ureterogram for the advanced cases.

If the ureter catheter will not pass the obstruction, and even if no urine is obtained, urography locates the obstruction and usually a little fluid passes into and outlines the dilated ureter above.

When urography has to be employed, the injected fluid must be drained off before removal of the catheter and the kidney pelvis washed out with a little saline solution.

The practice of taking the urogram with the patient erect exhibits the excursion of the kidney but so magnifies the kinking of the ureter as to mislead the unwary.

Ureter kinks below the pelvic outlet and in the upper third of the canal are the result of renal mobility and do not obstruct. Careful observation will show that the ureter is dilated below as well as above them, due to an obstruction lower down.

The customary measure of small renal retentions is to make a second urogram ten minutes after the first. During the interval the unobstructed ureter will have emptied the kidney.

TREATMENT

In view of the dependence of hydronephrosis upon renal retention, the immediate therapeutic indication is to relieve retention by removing the obstruction to the outflow of urine through urethra or ureter.

In this connection it must be remembered that minimal obstructions to ureteral peristalsis, if persistent over years of time, can utterly dilate and destroy the kidney above. Yet the relief of such an obstruction may require only the occasional passage of a No. 10 ureter catheter.

Even if the obstruction cannot be removed, the gentle and intelligent care of the situation may extend a crippled life in seeming health for years.

Hinman's theory of renal compensation and balance warrants the removal of dilated kidneys only when obstruction cannot be relieved. The mere dilatation of a kidney does not call for any treatment after the relief of back pressure.

The majority of hydronephroses are bilateral and as the kidneys dilate the renal function is progressively more and more impaired. Yet if not disturbed or superinfected by too much instrumentation, the patient may survive, lean but otherwise in seemingly excellent health, for years with what seems only a shell of kidney tissue and a fixed urinary dilution and only a trace of phenolsulphonephthalein output. But with both kidneys involved the indication is im-

mediate and imperative that each of them be relieved of back pressure by: Manipulation (removal of stones, dilatation of stricture); operation (prostatectomy, liberation of ureter kink, stone, etc.). Or, if these are impracticable or fail, by: Derivation of the urine (cystotomy, ureterostomy, pyelotomy); nephrectomy.

The detail of treatment of ureteral obstructions is discussed in Chapter XVIII.

In deciding whether a kidney shall be removed or an attempt made to save it, the determining factor is the condition of the opposite kidney. If this is uninfected, unobstructed and already accustomed to an overload, nephrectomy is the operation of choice for a kidney that cannot be decompressed. Cutaneous ureterostomy is the operation of choice under such circumstances, if the opposite kidney is absent or its function gravely impaired. The dilated ureter fits a patient for cutaneous ureterostomy and unfits him for intestinal ureterostomy.

CHAPTER XXXIV

ENURESIS; BLADDER HERNIA; BLADDER FISTULA

Incontinence of urine, or enuresis, is that condition in which the urine flows involuntarily out of the bladder as soon as it flows in. Incontinence must be distinguished from overflow. In each there may be a continual involuntary dribbling; but in the one case the bladder is empty, in the other it is full. Enuresis shows that the vessel leaks; overflow shows that the outflow pipe is obstructed. In the adult male dribbling of urine almost always signifies overflow. If there is true incontinence the urine flows away without any pain or desire to urinate. Imperative urination, when the inflamed bladder contracts every few minutes with a force that the cut-off muscle cannot oppose, is spoken of as false incontinence.

Incontinence may be partial or complete, diurnal or nocturnal.

Incontinence in Adult Males.—Stagnation with overflow and false incontinence have been already considered. True incontinence depends upon:

1. Postoperative enuresis, from overcutting the vesical sphincters
2. Paralysis of the bladder
3. Tuberculosis of the neck of the bladder
4. Persistence of infantile incontinence

Incontinence in Adult Females.—Women have weaker bladder sphincters than men, and among them such lesser irritations as uterine displacements, the pressure of tumors, and even trigonitis, may excite a most persistent and annoying incontinence of urine.

ENURESIS OF CHILDHOOD

Infants have little or no control over their urination, especially at night, but after they leave off diapers they are expected to stop wetting the bed. Few children fulfill this expectation entirely. Up to the age of five or six an occasional accident may occur to the most normal child. But this is not enuresis. The true noctural enuresis of children—for it is only exceptionally diurnal—is not noticed, as a rule, until the child is five or six years old. Then he begins to wet his bed quite regularly, perhaps two or three times every night. He may also lose his urine involuntarily by day, and very rarely the incontinence occurs only by day and not by night.

Etiology.—The cause of enuresis is sometimes obvious enough, but usually obscure.

1. Enuresis due to congenital deformity such as epispadias is readily diagnosed.

2. Enuresis due to tuberculosis or stone is overlooked with singular frequency. The little patient cries out when he urinates and complains of various pains, but the physician often fails to consider the symptoms and neglects to examine the urine. Needless to say a careful examination should precede the treatment of any case.

3. Many cases are associated with phimosis, pin-worms, adenoids, hypertrophied tonsils, and other of the minor diseases of childhood. The enuresis may often be relieved by their removal and is therefore usually spoken of as reflex. Without quarreling about the treatment, one may question the theory. These little lads are often thin and anemic and their enuresis is apparently due to this general condition rather than actually reflex. In general it may be said that a child with enuresis who is below par should be a subject for hygiene in the hope that the improvement of his general condition may relieve the bed-wetting.

4. Enuresis is often due to paralysis resulting from spina bifida.

5. Enuresis is occasionally associated with such nervous disorders as chorea, tabes, etc.

6. There remains a large, perhaps *the* large, class of patients still unaccounted for. Their adenoids have been removed, the patients are not anemic, deformed or tuberculous, their urine contains no pus, and their nervous system is intact. The cause of enuresis in these cases is unknown.

The three theories to account for it are: (1) Insufficient nervous impulse, (2) thyroid insufficiency, (3) mild tuberculosis.

Prognosis.—Even though all treatments fail, the prognosis is excellent. With the advent of puberty most children stop bed-wetting.

Treatment.—The treatment of the enuresis should be preceded by a careful examination of the patient for enlarged adenoids or tonsils, for pin-worms, for adhesions of foreskin or clitoris, the urine should be examined if pus is found, stone or tuberculosis may be suspected. The blood should be examined for anemia, and the child carefully gone over for evidences of tabes, spina bifida or chorea.

The treatment of functional enuresis is successful in proportion as it is begun early. Enuresis, like constipation, is a habit that becomes fixed through neglect. The attentive mother will strive with the child while it is yet an infant to break it into cleanly habits. True enuresis not infrequently appears after an interval of some years during which the child was quite normal. This must be a signal for the mother to resume her care. The child will usually hold its urine up to a fixed hour. When this is the case, it should be awakened before this hour in order to empty the bladder and thus form a habit of not losing its urine involuntarily.

If there is no fixed hour, the night must be divided into periods of two or three hours each, at the end of each of which the child shall be awakened.

If these simple means fail, there are a great many methods of treatment from which the physician may choose but none of which seem to offer any very direct

promise of cure. Belladonna has been much employed but young children are especially sensitive to belladonna. I have seen a four-year-old child delirious from a single dose of atropin, 1/500 grain, by mouth. Many local treatments such as the passage of a urethral sound or the application of galvanic electricity to the deep urethra have been recommended. The psychic shock to the child by the use of such remedies may quite as probably be harmful as beneficial. Cathelin many years ago suggested the injection of salt solution into the sacral canal as a stimulation to the sacral nerves which might help control enuresis. Though there is some doubt as to whether the action is a physical or a psychic one, I have rather favored this treatment, it seems to me less shocking to the child than the passage of instruments into the urethra.

The draft for the army ten years ago revealed the existence of a surprisingly large number of adults suffering from enuresis. I do not know that any of them were benefited by the treatments to which they were subjected. It would be interesting to apply to such a patient one of the reefing operations for the cut-off muscle.

POSTPROSTATECTOMY ENURESIS

Temporary incontinence of urine may follow any operation about the bladder neck. It is the permanent conditions, *i.e.*, those that last longer than three months, which concern us. These are evidently due to injury to both sphincters. For operations upon the strictured urethra, though they divide the external sphincter, do not cause incontinence and suprapubic prostatectomy, though it may be followed by a temporary incontinence, does not leave a permanent defect unless a previous or subsequent operation weakens the external sphincter. Perineal prostatectomy is the usual operative occasion for incontinence of urine because it always leaves a relaxed internal sphincter and sometimes divides or destroys the innervation of the external sphincter.

One may hope that an inability to retain urine following operation will be controlled by the patient as his tissues heal. Six months may be given for this, during which every effort should be made to clear up infection and to improve the patient's general health. Whatever incontinence remains at the end of six months is permanent and requires operative relief.

PARALYSIS OF THE BLADDER

Paralysis of the bladder is the result of any spinal lesion that destroys the function of the sacral plexus. Hemiplegia habitually does not imply bladder paralysis—paraplegia does.

Temporary bladder incoördination, *e.g.*, such as follows operations about the pelvis, should not be classed as paralysis of the bladder; it is rather a functional inhibition. Thus postoperative retention of urine is due to the pain felt by the patient when he makes the expulsive effort. The inability of such a patient to pass urine is precisely on a plane with the inability to swallow food which follows removal of the tonsils.

The paralysis of the bladder as a result of tabes dorsalis is so peculiar a phenomenon that it is given special consideration below.

The first symptom of paralysis of the bladder is retention. The trigonal muscle cannot pull open the sphincter. This retention comes on gradually or suddenly, depending upon the character of the spinal lesion. The paralysis is usually complete and when so, the patient is unable to pass a drop of urine for a period varying roughly from a week to a month, at the end of which time the "automatic" bladder is established, *i.e.*, the bladder, at first full, begins involuntarily to leak a small quantity of urine from time to time. As the bladder becomes more and more automatic, the amount of urine retained becomes less and less until finally the retention is no more than 100 c.c. or so, possibly much less this this. The patient is then in complete incontinence with an empty bladder.

Paralysis of the bladder implies atrophic changes in the tissues exhibited externally by the readiness with which pressure sores develop and internally by the fact that these patients tolerate the indwelling catheter very badly. Even interrupted catheterization traumatizes the tissues far more than it would in a normal urethra. Infection is more prompt, more severe, more difficult to control. It leads immediately to pyelonephritis which destroys the renal parenchyma relatively rapidly. The usual cause of death from fracture of the spine or other types of paraplegia is renal infection and insufficiency.

Colonel Besley, noticing the disastrous effects of catheterization of the paralyzed bladder due to war wounds of the spine, and recognizing that the patient has but a few weeks between the beginning of his paralysis and the establishment of the automatic bladder, proposed treatment by narcotics and manual pressure on the hypogastrium to squeeze out the contents of the bladder as completely as possible while giving the patient hexamethylenamin to minimize the dangers of spontaneous infection and under no condition passing a catheter.

This treatment is highly to be commended, but only for paraplegics whose associated anesthesia permits them to bear the distention of the bladder. (All others must be catheterized.) Hexamethylenamin exhibits its antiseptic properties better in retention such as this than under any other circumstances. It should be given in as high a dose as the patient can bear and with ammonium chlorid unless the urine is already acid. But although it is proper to neglect all of the usual rules for catheterization in the effort to get these patients through their period of retention without the passage of a catheter, one cannot entirely neglect their outcries and all but the paraplegic manage to be catheterized. Colonel Besley's treatment is the ideal one when it can be carried out. In civil practice the bladder paralyses due to spinal disease are relatively slow to become complete and the automatic bladder is correspondingly slow to establish itself. Under these circumstances it is proper to give in at once and catheterize the patient often enough to prevent discomfort. The bladder will rapidly dilate and, as a rule, the patient does not require to be catheterized more than two or three times in the twenty-four hours. The administration of hexa-

methylenamin should be continued until the automatic bladder is established with no more than 25 c.c. of residual urine.

THE TABETIC BLADDER

Paralysis of the bladder is one of the early peripheral manifestations of tabes. The clinician must recognize that when a patient, old or young, is unable to empty his bladder and no sufficient reason for this appears, he doubtless has tabes. Paralysis of the bladder due to tabes begins slowly, may never become complete or may rapidly lead to complete retention of urine. It may occur at a time when the patient still preserves his knee-jerks. The ankle jerks and the deep muscular sense are inevitably lost. The spinal puncture makes the diagnosis.

I shall never forget the dramatic scene when a neurologist (having carefully examined a patient whom I suspected of tabes because of a retention of urine without organic obstruction) turned to me and said, "The absence of ankle jerks might mean tabes, but I can find no other sign"—and the nurse handed me a slip showing a spinal fluid analysis characteristic of tabes.

An even more elusive type of bladder paralysis is exhibited by the patient who reports at the physician's office with some obscure symptoms of a paresthetic character such as twitchings or abnormal sensations about the pelvis or the lower abdomen and exhibits a slight derangement of micturition, a little frequency of urination, possibly some abnormal sensations accompanying the act. Such a patient, especially if he has a negative blood Wassermann and has not yet lost his knee-jerks, is not likely to be suspected of tabes.

Tabetic bladder paralysis is diagnosed by the angle at which the cystoscope lies in the patient's bladder. The paralysis of the internal sphincter permits the bladder end of the cystoscope to drop downward and the tension upon the triangular ligament deflects the ocular end upward so that the shaft of the cystoscope rests at an angle quite the opposite to that assumed by it when there is prostatic retention grasping the bladder end of the cystoscope.

Many cystoscopists have described types of bladder trabeculation as characteristic of the tabetic bladder. None of these descriptions has fulfilled its purpose. The paralysis does cause a trabeculation more marked than one would expect to find as the result of a given retention. But this difference is in no way characteristic. The only cystoscopic evidence of bladder paralysis is the open internal sphincter.

The posterior urethroscope demonstrates this open sphincter very plainly and will confirm the impression derived from the angle at which the cystoscope lies.

The tabetic bladder, though it is chiefly characterized by retention, is also afflicted by incontinence of urine. Exceptionally the incontinence predominates and the patient is in a condition of "automatic bladder." As a rule, the incontinence is slight and irregular. The patient is never sure that a cough or sneeze may not eject a considerable amount of urine.

This sphincteric weakness may be measured. Though the capacity of the tabetic bladder is likely to be great, the pressure at which the desire to urinate is felt instead of being about 16 mm. may fall as low as 2 to 5 mm.

As to prognosis, this is as slow and indefinite as that of tabes itself. There is a totally unscientific aphorism that "tabetics never die" which has its sentimental merits; yet it is doubtless true that 50 per cent of tabetics die of renal infection and renal insufficiency (Barney).

The treatment of the tabetic bladder is primarily that of the tabes. Early antisyphilitic treatment may actually overcome a complete retention of urine. I have known this to happen more than once.

Hexamethylenamin is almost a specific for the tabetic bladder. When the patient is first seen, the drug should be given in increasing doses until bladder or gastric irritation shows that the limit has been reached. Its administration is then continued just below this dose, with ammonium chlorid if the urine is not acid, until there is no more question of any local treatment of the bladder. After this, the drug is continued at a dose just sufficiently high to keep the urine clean. An intelligent and careful patient can almost perform miracles by learning and carefully watching the effects of this urinary antiseptic upon his paralyzed bladder. Thirty years ago my father transferred to my care a tabetic who had been suffering from bladder paralysis for twenty years. Every known local antiseptic had been tried upon him in vain. The bladder was contracted, the catheter had been passed every hour, the urine was filthy and had been so for years. I put him on hexamethylenamin; 1 gram a day was all he could take without intense bladder irritation. But on this dose the chronic infection cleared up until the urine looked grossly normal, and though he continued to use the catheter every hour, his bladder was painless and his urine was clear during the remaining ten years of his life.

This singular efficacy of hexamethylenamin cannot be guaranteed. It conquers coccic infections much more brilliantly than infections of the colon type, yet it may be accepted as a general rule that internal antisepsis will probably help the tabetic bladder more than any local antisepsis.

The catheter should be employed by the patient and as rarely as possible. In as much as the patient feels a desire to urinate with a very low bladder pressure, he does not need the decompression that the prostatic requires and may with impunity permit his bladder to fill until he feels a distinct desire to urinate before passing the catheter. Or if the retention is partial, he may depend wholly upon internal antisepsis and not pass his catheter at all so long as he can thus control his infection and the progress of his renal insufficiency.

Yet this does not mean that the patient should torture himself with the struggle to get on without a catheter while his bladder is daily growing more inflamed and irritated. The catheter is just as much a friend to the tabetic as it is to the prostatic but, like a true friend, it must be handled intelligently.

The combination of prostatic enlargement and a tabetic bladder has been occasionally cured by prostatectomy. It is, of course, difficult to distinguish the

presence of bladder paralysis when the prostate is enlarged, and in a doubtful case prostatectomy may properly be advised in the hope that it will relieve retention. Yet if there is actual paralysis of the bladder as shown by the lowered intravesical pressure, it is not certain that removal of the enlargement of the prostate will restore a normal function to the bladder.

But with his prostate out the patient will live longer than with it in, even though the operation does not relieve the retention, for the passage of the catheter does not traumatize the widely open paralyzed bladder neck as it does when the bladder neck is closed by prostatic obstruction. The tabetic is as good a subject for catheter life as the prostatic is bad.

VAGINAL CYSTOCELE

Cystocele is the result of obstetrical laceration and even though the bladder is protruded from the vulva with complete prolapse of the pelvic floor and uterus this constitutes rather a gynecological than a urinary disorder. The bladder irritation that results is a minor phenomenon as compared with the inconvenience caused by the uterine prolapse.

Vaginal cystocele does not cause retention of urine unless there is sclerosis of the bladder neck or stricture of the urethra.

Cystocele interferes with cystoscopy by lowering the bladder floor so that it is not easy to find the ureter orifices and obliterates the trigonal markings so that the ureter mouths appear as insignificant slits, very difficult to find.

HERNIA OF THE BLADDER

The bladder may form part of the contents of any pelvic hernia, abdominal, inguinal, crural, perineal, ischiatic or through the foramen ovale.

Among twenty-two femoral cystoceles collected by Gibson, sixteen occurred in women, while seventy among his seventy-seven cases of inguinal cystocele occurred in men. Lotheissen collected 113 cases of inguinal cystocele in men and only eleven in women. He believes that cystocele occurs in 3 per cent of all inguinal herniæ, although the usual estimate is from 1 to 2 per cent. Inguinal cystocele is extraperitoneal in 70 per cent of cases, paraperitoneal, "mixed," in 25 per cent, and intraperitoneal in only 5 per cent. As extraperitoneal cystocele is met with only in direct inguinal herniæ, it is in this class of cases that cystocele is to be looked for.

Cystocele is especially common between the ages of thirty and sixty. Its pathogenesis, depending partly upon the hernial traction, partly upon dilatation of the bladder, has been studied by Lotheissen, Lambret,[1] Cheesman[2] and Alessandri.[3]

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[1] *Bull. méd.*, 1899, xiii, i, 397.
[2] *Med. Rec.*, 1901, lix, 985.
[3] *Guyon's Annales*, 1901, xix, 25, 153, and 325.

Diagnosis.—The diagnosis is rarely made before operation. The suspected presence of cystocele may be verified by cystography.

Treatment.—The treatment of inguinal or femoral cystocele is herniotomy.

VESICO-INTESTINAL FISTULA, PNEUMATURIA

Vesico-intestinal fistulæ are congenital, traumatic or due to disease.

Congenital communication of the bladder and rectum in the form of a cloaca is an extremely rare deformity usually associated with other and fatal ones.

Traumatic fistula is the result of operation or of gunshot or other wounds.

Fistula due to disease is usually the result of carcinoma of the bladder or of the bowel. Next in order of frequency come fistulæ due to diverticulitis of the colon. A few cases have been reported as the result of perivesical suppuration, of bladder tuberculosis, of carcinoma of the cervix, of appendicitis. I have not seen any such and shall not attempt to describe them.

Carcinoma of the bladder will probably rank high as the occasion for intestinal fistula during the next few years because of the tissue-destroying effects of radium or the other cauterizing methods applied to the cure of this disease. The fistula will habitually be in the base of the bladder and will communicate with the rectum.

Fistula due to diverticulitis of the colon occurs by adhesion of the sigmoid flexure to the bladder in the region of one or more inflamed diverticulæ. The lesion in the colon is generally quite extensive, and widely adherent to the bladder. The scarring in and about the gut often constricts this considerably, a fact to be taken into consideration when operation is performed. In contrast to this the hole in the bladder is usually little more than a pin puncture in size and is likely to be in that mid-portion of the subperitoneal part of the bladder which is the blind-spot of the prismatic cystoscope. A secondary cystitis is kept up by the feces that pour into the bladder and in the midst of this it may be extremely difficult to identify the perforation by cystoscope.

Symptoms.—The initial symptom of vesico-intestinal fistula is the bladder irritation due to adhesion of the sigmoid diverticulum or abscess of appendix to the bladder. This irritation may be slight and pass unnoticed as may the actual rupture with its discharge of at least a small amount of blood and pus in the urine. As a rule, the patient reaches the urologist after the condition has existed for some time. The patient complains of a chronic cystitis and if pneumaturia has not been noted, the diagnosis of intestinal fistula can only be made by the discovery of intestinal contents in the purulent urine, the hole in the vault being so small that it will be overlooked by the cystoscope.

The cardinal symptom of intestinal fistula is pneumaturia. It may dominate the scene, the patient complaining only of a very slight bladder irritation but of the occasional passage of considerable quantities of gas in the urine. On the other hand, the cystitis may be severe, the pneumaturia so slight as to be overlooked.

As the condition progresses the constant pouring of feces into the bladder results in stone formation and here again if the pneumaturia is slight, casual diagnosis may overlook the fistula and be satisfied with the diagnosis of stone.

Diagnosis.—Pneumaturia means intestinal fistula. Much has been written about gas-forming bacteria causing pneumaturia. But the several cases of supposed spontaneous generation of gas in the urine seem to have been misinterpreted fistulæ.

The diagnosis is confirmed by cystoscopy, which finds the hole in the bladder. Biopsy of the granulation tissue around this hole will disclose the presence of carcinoma.

In the absence of pneumaturia, the diagnosis will be suggested by the appearance in the urine of food fragments or feces.

Confirmatory diagnosis of the bowel condition is given by the barium enema, or, if the fistula is high, by the bismuth meal.

Treatment.—The treatment is that of the original intestinal lesion. When the patient comes to operation, the involvement of the bladder scarcely complicates the procedure. A cuff of bladder wall surrounding the fistula is excised and the bladder sutured without drainage of its cavity, but with an extraperitoneal drain to the point of suture. The difficult part of the operation is the relief of the intestinal diverticulitis, carcinoma or tuberculosis with its accompanying obstruction of the lumen of the bowel and the masses of perisigmoid infiltrate.

I have known but one vesico-intestinal fistula to close spontaneously. This patient came to me in 1903 with a history of pelvic abscess, rupturing first into the bowel and then into the bladder. This had permitted successive diagnoses of typhoid fever, colitis, cystitis, bladder stone. When her physician informed her that the hairs around which the stones formed (Fig. 91) had been swallowed and that the pneumaturia was of no importance, she changed her doctor. I removed a small ovarian dermoid and was unsuccessful in my effort to close the two ends of the fistula. She was left with a traumatic vesico-intestinal fistula which discharged lessening quantities of gas from 1903 to 1911. During this time she would not permit cystoscopy, much less an operation. From 1911 to 1928 her fistula has been spontaneously closed, her bladder normal, though her urine still shows pus cells and colon bacilli, doubtless from a mild pyelonephritis.

VESICOVAGINAL AND UTERINE FISTULÆ

Vesicovaginal fistulæ are common, vesico-uterine fistulæ rare results of puerperal trauma. The fistula may involve the ureter as well as the bladder. The one important clinical feature of such fistulæ is that they should be immediately recognized and repaired as soon as the separation of slough permits. If the urine is permitted to run out through the vagina continuously for any length of time, mixed infection of the sinus and adjacent portions of the bladder results, calculous incrustations form upon the granulations and the painful

cystitis reduces the patient to a miserable state and renders plastic operation exceedingly difficult.

Therefore the obstetrician's first care must be to keep the bladder and vagina clean by daily bladder irrigations until the weeks have passed that are required for separation of the slough.

Then a plastic operation must be devised to fit the case. I have not operated upon vesicovaginal fistula. To read the reports of others is to encourage the utmost confusion. All are agreed that a small fistula, opening low down in the vagina, may be operated upon with hopeful success by excision and suture in two layers by the vaginal route. Chute insists that, as an essential part of the cure, the patient should be trained to lie upon her abdomen so that after the operation she may constantly lie in this position. Young [4] reports a cure by an intravesical operation consisting essentially of lifting up the fistula by finger in the vagina or by a special barbed instrument, excision of the scar and suture of vagina and bladder in separate layers from within the bladder. Beer has had successes by complete dissection of the bladder, throwing this out of the abdomen and thus suturing the two ends of the fistula separately. The gynecologists all prefer the vaginal route, for the details of which the writings of George Gray Ward [5] may be consulted.

If all plastic operations fail, implantation of the ureters one by one into bowel or skin is the ultimate resource.

URACHUS FISTULA

The following observations are founded upon the report of Begg: [6]

"In embryos of 10 to 24 mm. the bladder, which in its upper part is derived entirely from the ventral cloaca, reaches the umbilicus. As development progresses, the organ retains the same position, but its upper part or apex narrows more and more and becomes the urachus. The latter is simply the modified superior extremity of the bladder and owes nothing to the allantois. . . .

"At birth the urachus reaches the umbilicus and is attached to it by three fibrous strands" (the two umbilical arteries and the allantois). "Immediately following birth the bladder begins its descent, taking the urachus with it. The latter leaves the region of the umbilicus altogether, dragging the obliterated ends of the umbilical arteries with it and pulling the fibrous tissue of the umbilical scar into a long strandlike tissue.

"The end-result of this process, as seen in the adult, is the following: The urachus, rarely more than 5 cm. in length, passes up from the anterior wall of the bladder just below the apex. Its upper extremity is fully 11 or 12 cm. inferior to the umbilicus, but is connected to it either by a single cord of fibrous

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[4] *Surg., Gynec. & Obst.*, 1927, xlv, 226.

[5] *Surg., Gynec. & Obst.*, 1910, xi, 22-27; 1917, xxv, 126-133; 1921, xxxii, 150-152; 1923, xxxviii, 678-682.

[6] *Surg., Gynec. & Obst.*, 1927, xiv, 165.

tissue, or more commonly by a series of fine diverging strands which unite at their upper parts. These strands, first described by Luscka and known as Luscka's plexus, are derived largely from the adventitia of the umbilical arteries, teased out by the descent of the urachus. . . . (The urachus) is itself sometimes torn asunder, and as its canal at this stage communicates with the bladder in 33 per cent of cases, tiny drops of urine may be liberated into the transversalis-peritoneal space and give rise to septic effusions." Such are the "septic urachal cysts."

The urachus does not therefore reach from the umbilicus to the bladder. Nor is its canal obliterated. "Only the pathological or undescended urachus even approaches the umbilicus." "The adult urachus varies in length from 3 to 10 cm., averaging 5 cm." . . . The central canal has a uniform diameter of 1 mm. In one-third of the cases examined the canal opened into the bladder, in the other two-thirds it ended blindly just external to the vesical mucosa.

Congenital "urachus" fistula is actually a bladder fistula, due to the non-closure of the ventral cloaca and the non-descent of the bladder. Exstrophy of the bladder presents a typical picture of non-descent of the bladder and non-formation of the urachus.

Acquired urinary umbilical fistula "is never due to a patent or persisting urachus. Congenital fistulæ are of two varieties: The first includes the cases in which the urine flows freely or perhaps exclusively from the umbilicus." They are easily closed, *e.g.,* by circumcision or spontaneously, but tend to reopen if there is back pressure in later life. "The second variety includes the cases in which the urine escapes drop by drop." They are due to retarded closure of the cloaca; but when once cured, the bladder tends to descend naturally; the urachus forms; there is no tendency to reopen.

There are two types of acquired fistulæ: (1) The bladder does not descend; vesico-umbilical fistula forms. (2) "The urine escapes through the dilated terminal end of the urachal canal or through the weak point at the junction of the urachus with the bladder." An abscess forms and fills the prevesical space and issues through the abdominal wall either at the umbilicus or below it.

CHAPTER XXXV

THE DIAGNOSIS OF HEMATURIA

When a patient reports that he is passing blood in his urine, the first point to be determined is, What part of the urinary tract does the bleeding come from?

The probable answer to this question may often be derived from the history. Thus, if a sound has been passed and the next day the patient reports that micturition has been painful and the urine bloody, one may infer that the bleeding is urethral and due to the passage of the instrument. But if he still has on the underclothes he wore the day before and they show no stain of blood, if the bleeding has been profuse, the passage of urine painless, such an inference would not be justified. Hence, however natural it might seem to attribute hematuria at a given moment to a stated cause, this should not be done until the patient's description of his bleeding, confirmed by a sufficient physical examination, shall have substantiated this opinion.

Bleeding from the anterior urethra, or urethrorrhagia, flows from the meatus continuously or intermittently, independent of micturition. If the urine is passed in three glasses, the first will contain the blood washed from the urethra, the last may be stained with blood squeezed out by the last wave of muscle spasm, the intermediate urine will be free from gross blood, unless the bleeding is very free.

Bleeding from the posterior urethra must be very free to appear at the meatus between urinations. But it may appear in varying degrees in any number of glasses into which the urine is passed; the striking feature being, not that this or that glass shows the most blood, but that the different glasses show a variation. Thus there may be blood in the urethra at the time of urination; if so, the first urine passed is blood-stained; otherwise not. The muscular effort that ejects the last drops of urine may force out a few drops of blood toward the end of urination: if so, there is terminal hematuria, *i.e.*, the last drops of urine passed are more bloody than that previously passed; otherwise not. If the bleeding is free, every glass into which the urine is passed will contain blood, but there will be more blood in either the first or the last glass than elsewhere.

Bleeding from the prostate has the character of bleeding from the posterior urethra. Either may cause hemosperm, but hemosperm unaccompanied by hematuria is likely to be due to bleeding in the seminal vesicle rather than in the prostate.

Bleeding from the bladder may occur independently of urination or may be excited by the act or increased by it. If not excited by urination the blood is distributed evenly through all the urine passed. It is more usual that the

act of micturition occasions or increases the bleeding. This, as a rule, makes the hematuria predominantly terminal but if the bleeding is from a frond of papilloma caught in the internal sphincter or from an ulcer at the bladder neck, the blood may precede the urine.

Blood from the kidney is likely to be distributed evenly through the urine, like that from the bladder, but terminal hematuria never occurs except in the sense that clots accumulated in the bladder may be ejected in the last urine passed in great quantity.

Stale brown blood usually comes from the kidney, never from the urethra. It may be from the bladder only on condition that there is some retention of urine.

Clots from the urethra precede urination, from the bladder follow, from the kidney are usually throughout the urine.

PAIN ACCOMPANYING HEMATURIA

Pain accompanying hematuria may help locate the bleeding, as follows:

Pain due to tension on the kidney capsule is usually confined to the loin. It is often accompanied by:

Pain in the renal pelvis if felt at a point nearly opposite the umbilicus at the outer border of the rectus (above the point of appendix pain, below that of gall-bladder pain). It is often accompanied by pain in the kidney, making the patient place the pain both in front and behind, and by:

Pain in the ureter is felt at any point from the above to the bladder, over the appendix region, in the groin, in the pelvis, and radiating chiefly to the testicle (labium of the female) or to the bladder, causing frequent and painful urination. It may radiate to the lower back, to the thigh, to the rectum. (The Head zone of skin hyperesthesia extends to the inner side of the upper half of the thigh.)

Painful urination is by no means an indication that the lesion causing the pain is in the lower ureter. Many patients who know they have a ureter stone declare they can feel each successive colic lower and lower in the pelvis. Watch closely and you will find this observation just as frequently inaccurate as not. Stone in the kidney pelvis may produce a reflex bladder discomfort as its only painful symptom. Stone at the very lower end of the ureter, in that part of the canal that is within the bladder wall, usually produces bladder irritation without pain in the side (unless the ureter above is distended).

Bladder pain is usually exhibited in the form of an inability on the part of the bladder to contain much urine (which makes the passage of urine frequent) and a sensitiveness to distention and to the squeezing out of the last drop of urine (which makes the passage of urine painful, throughout the act of micturition, at its beginning or at its termination). Terminal pain and terminal bleeding often go together.

Bladder pain may be referred to a bewildering variety of spots. Open the

bladder suprapubically and touch the unanesthetized mucosa near its apex; the patient will complain of pain at the end of his penis. Yet overdistention a moment before led him to complain quite accurately of a desire to pass water.

A patient with bladder lesion may complain chiefly of rectal spasm, while a rectal fissure may elicit chiefly the symptoms of bladder irritation.

A papillary tumor of the bladder unaccompanied by cystitis and seemingly not calculated to excite pain may cause annoying backache. Burn off the tumor and the pain disappears.

Pain in the seminal vesicle is felt locally as a pain up inside the rectum or is referred to the groin (ache in the groin is as often due to deferentitis or to small hernia) or to the sacro-iliac region.

Pain in the prostate or about the verumontanum or utricle overlap so that it is impracticable to disentangle them. The classification we give is therefore merely suggestive. Many exceptions will be found to it.

The characteristic pain due to inflammation of the utricle is pain on ejaculation.

The characteristic pain complex of the veru is premature ejaculation, with or without pain, and perhaps (*a*) painful urination, (*b*) pain on the under surface of the penis, just back of the glans, or all along the penis, or (*c*) discomfort or pain when sitting, the discomfort being felt in the perineum and in some individuals excited more by a hard seat, in others by a soft one that presses upon the perineum.

Pain arising in the prostate is said to extend to any of the above-named regions. If the prostate is acutely inflamed the characteristic pain complex arising from the tension upon the prostatic capsule is frequent and painful urination and a sense of tension, heat and discomfort up the rectum.

Pain arising in the anterior urethra seems not to be referred to other points.

THE LESION THAT BLEEDS

The diagnosis of the lesion that occasions hematuria cannot be summarized. It requires all of our diagnostic equipment and clinical experience. Yet some clinical data, generally but not universally true, may be set down.

I have seen a number of cases of hemosperm, some of them associated with hematuria. They were due to prostatitis, vesiculitis, prostatic calculi. I do not recall having seen one due to neoplasm. Such hematuria or hemosperm in a young person otherwise normal (and, alas, sometimes in an old one) is usually due to sexual strain.

Between the ages of fifteen and twenty-five terminal hematuria is usually due to sexual excess or tuberculosis, renal hematuria to tuberculosis, hydronephrosis or pyelonephritis. The two last named often begin with microscopic hematuria, frequently with macroscopic hematuria. It is so easy to forget this.

From twenty-five to forty-five tuberculosis becomes a less and stone a more frequent cause of hematuria.

From thirty-five to fifty the more severe hematurias are more and more attributable to tumor. A tumor hemorrhage occurring before the age of forty-five is almost always vesical.

The combination of prostatic enlargement and bleeding therefrom suggests hyperplasia, not neoplasm.

A brief terminal bleeding may be the only symptom of an acute prostatitis. But this is only discovered accidentally. Yet prostatitis metastatic from the upper air passages is usually ushered in by hematuria. If the inflammation were tuberculous, the bacillus would almost certainly be found.

Tumor Bleeding.—By tumor bleeding we understand bleeding from a tumor of the bladder or kidney.

Characteristic tumor bleeding is spontaneous, profuse, total, painless, unaccompanied by any other symptom except the pain caused by the passage of clots (renal, colic, dysuria), unaccompanied by infection (until this supervenes) and stopping as spontaneously as it began. Almost all tumors in the adult bleed in this manner. The only other lesions (except trauma) that bleed as freely are varicose veins of the bladder (extremely rare) and tuberculosis. But free bleeding from a tuberculous kidney, without discernible pus or acid-fast bacilli in the urine, is only one degree less rare than that from varicose veins. The bleeding from tuberculosis is an early lesion and therefore occurs at a time when tumor of the kidney is rare.

Tumor, trauma and tuberculosis are the only lesions of the kidney that bleed sufficiently freely to clot the blood after it reaches the bladder. Such clots are so large that they pass with some difficulty through the urethra and may cause retention of urine.

The bleeding of tumor is characterized not only by brevity and spontaneity, but also by the brevity of the bleeding in contrast to severity. And during the first year the intervals between bleedings are often many months long, the bleedings short.

IDIOPATHIC RENAL HEMATURIA

The Bleeding That Imitates Tumor.—But the bleeding of tumor is not always so characteristic as all that. It may be occasioned by a fall, be dribbling and continuous in character, or apparently controlled by medication. The most malignant tumors do not bleed at all until they have grown so large as to be almost beyond control. They then proceed to bleed almost continuously and mildly.

Hence the bleeding of tumor is imitated by a number of lesions that are rather more familiar to the internist than they are to the urologist. Most familiar is the bleeding from Bright's disease. Next in frequency, to judge from my experience, are the angioneurotic renal hemorrhages. Next those that are thought of nowadays as due to papillitis. Hemophilia and purpura must be thought of if no other diagnosis fits. A sharp brief renal hemorrhage may be

the result of such minor strains as hitting (or failing to hit) the golf ball. Hexamethylenamin and many other drugs may cause renal bleeding.

But after all these diagnoses have been exhausted, there remain a few cases that exhibit bleeding from one or both kidneys over a long period without ascertainable cause. When the kidney is removed the pathologist is baffled by the mild or irregular lesions found, usually in or about the renal papillæ. Such cases we must still group under the title that confesses our ignorance, "idiopathic renal hematuria."

Before acquiescing in such a diagnosis the family and personal history must be searched for evidence of hemophilia or purpura; the question of exposure to cold carefully considered, for this is the usual cause of angioneurotic hematuria; the surgical causes of hematuria excluded by a complete urologic examination, including a urogram; the evidence for and against chronic nephritis weighed.

Pathology.—To enumerate the lesions of a condition whose pathology is unknown is a delicate task. When a kidney is removed for the relief of chronic hematuria of unknown origin it usually shows the lesions common to a mild parenchymatous nephritis (such as is familiar at the autopsy table, and not considered of any significance) and certain hemorrhagic lesions of the pyramids, such as are described by Goodpasture in two such kidneys removed by Quinby:[1] "In the first case vascular distention, rupture and hemorrhage is the essential feature. One can conceive therefore that the hemorrhage in this case might be due either to a rupture of the vessels through distention of otherwise normal channels or that the rupture was due primarily to injury of the thin vascular walls by some circulating agent. In the second case one cannot reasonably explain the lesion on the grounds of pure mechanical rupture since an inflammatory reaction is very obvious. Careful search within the area of inflammatory change has not revealed the presence of bacteria, yet there is distinct evidence of vascular injury which may possibly be explained on the assumption of the presence of bacteria in the lesions. The type of inflammatory reaction certainly indicates the presence of a local injurious agent, which it is not necessary to assume for the first case."

In other specimens a distinct papillitis has been found which had resulted in ulceration of the papilla. Such a condition is perfectly easy to recognize after nephrectomy for the swollen, red, ulcerated papilla is immediately distinguishable. But these changes will not show in the pyelogram, they cannot be distinguished before operation. Fenwick, who first described papillitis, proposed that the kidney be split and the papilla excised. This operation has been performed a few times, but even with the kidney split it may be impossible to identify the bleeding papilla and it is now generally conceded that splitting the kidney is a more dangerous operation than nephrectomy and likely to impair the kidney function so much as to render it not worth the risk. Accordingly we must depend for our diagnosis upon the exclusion of all other sources of hemorrhage and the clinical picture of idiopathic hematuria.

[1] *J. Urol.*, 1920, iv, 209.

The Clinical Picture.—The bleeding is like that of nephritis or *hematuria e frigore,* mild and continuous. It scarcely is intense enough to form little clots; it rarely forms large ones. Indeed, as a rule, the urine is not even bright red, but merely dark red with the urine forming the major part of the mixture. This bleeding may go on for weeks, months, years, intermittently or remittently. Barringer says that a bleeding that has continued for four years is not due to renal tumor. I prefer the statement that within less than four years the presence of a renal tumor will be declared by the character of the bleeding, the pain or tumor in the loin and the pyelogram.

Cystoscopic observation reveals that the bleeding comes from one kidney, not from both. Here let us repeat the warning that the diagnosis of renal hemorrhage must be made by observation of the ureteral jet. The ureter catheter is so likely to excite fresh bleeding from a perfectly normal ureter that the urine obtained through it shows pathological bleeding only under two conditions, viz., when the blood is old and brown, and when tumor bleeding with the passage of many large clots is excited by the catheter.

Treatment.—Idiopathic renal hematuria, whether due to papillitis or not, rarely threatens life, but it may keep the patient anemic and make him psychasthenic. Hence there is no hurry to remove the kidney. Any simple disturbance of pressure within the renal pelvis, such as the passage of the ureter catheter or irrigation of the pelvis with 1 per cent silver nitrate, has often checked the bleeding. Hagner once stopped a hemorrhage that had continued for thirty-six years by a single ureter catheterization. If the pelvis is irrigated it should be with a tissue astringent such as silver solution, not a hemostatic. Braasch[2] has reported seventy-seven cases; twenty-six checked by ureter catheter (four relapses); eighteen checked by pelvic lavage (three relapses); six checked by adrenalin injection (five relapses). Twelve nephrotomies netted seven cures. Nephrectomy was performed sixteen times with one death.

If the ureter catheter and injection treatments fail, decapsulation should be performed. It has relieved as large a proportion of cases as nephrotomy and is less destructive of renal tissue, less dangerous to life. If this fails and the hemorrhage is surely unilateral nephrectomy may be considered.

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[2] *J. Am. M. Ass.,* 1913, June 1.

CHAPTER XXXVI

CYSTS AND TUMORS OF THE KIDNEY

CYSTS

SEVEN varieties of cysts occur in and about the kidney. These are:

Multiple small cysts
Paranephritic cysts
Large cysts
Tuberculous cysts
Polycystic kidney
Echinococcus cysts
Dermoid cysts

Multiple Small Cysts.—Multiple small cysts are those dilatations of the renal tubules that are often seen in kidneys affected with chronic nephritis. They usually occur in the cortex and often project beneath the capsule. They may be single or multiple; they do not attain a large size and are of purely pathological interest.

Paranephritic Cysts.—Paranephritic cysts also may be dismissed with a word. They are extremely rare; they may arise from the suprarenal capsule; they may be hydatid or the result of an encysted perinephritic hematoma. They are not distinguishable from other cysts of the kidney except by exploratory incision.

Large Cysts of the Kidney.—Single, large serous cysts are occasionally found projecting from the surface of the kidney. Such cysts are usually single and unilateral. They may be associated with chronic interstitial nephritis. The contents of the cysts are serous or hemorrhagic, never urinous. Such cysts give rise to no symptoms unless they attain such a size as to produce a tumor or to cause pressure pain. Under these circumstances the tumor is habitually mistaken for hydronephrosis, renal echinococcus, ovarian cyst, or some other tumor. Exploratory incision reveals the nature of the disease. The treatment of such cysts is to peel them out of the kidney, which can be done with little difficulty, and to close the defect by mattress-sutures. If this is impracticable, cut away as much of the cyst as possible, sear the surface of the remainder with carbolic acid, and close the lumbar wound, leaving a drainage-tube to the kidney. When the cysts are multiple the smaller ones should be neglected. Engländer [1] has reviewed the reported cases from the surgical point of view.

[1] *Arch. f. klin. Chir.*, 1901, lxv, 112.

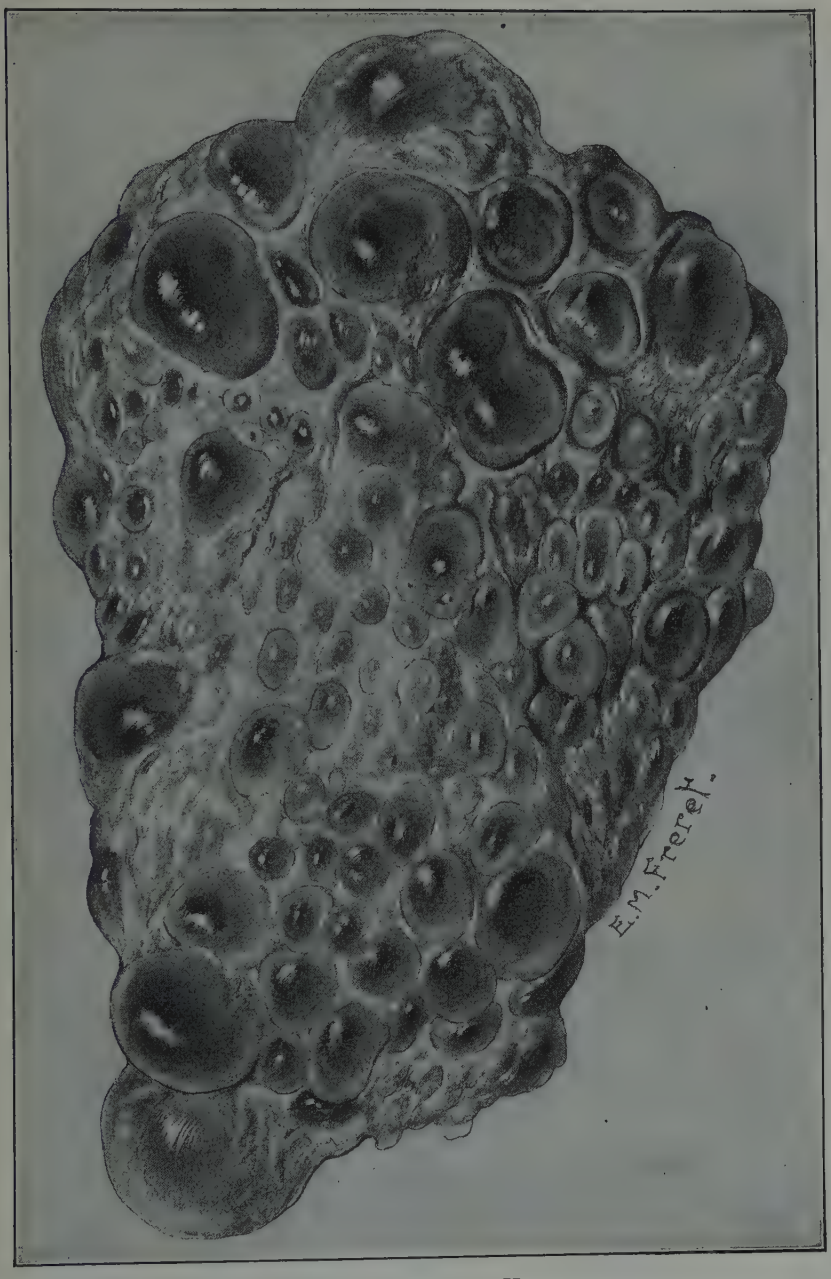

FIG. 105.—POLYCYSTIC KIDNEY.

Tuberculous Cysts.—Large cysts are frequently seen in the tuberculous kidney. They are the result of calical retention.

Polycystic Kidney.—The kidney is converted into a congeries of cysts which leave scarcely any of its parenchyma in a normal condition (Fig. 105). The pathogenesis of this condition is hotly debated, but without conclusion. That the cysts are not due to a local malformation is evident from the association of cysts of the spleen and the liver with those in the kidneys.

The disease appears at all ages. In the fetus the kidneys have been known to be so much enlarged as to obstruct labor. Certain writers have endeavored

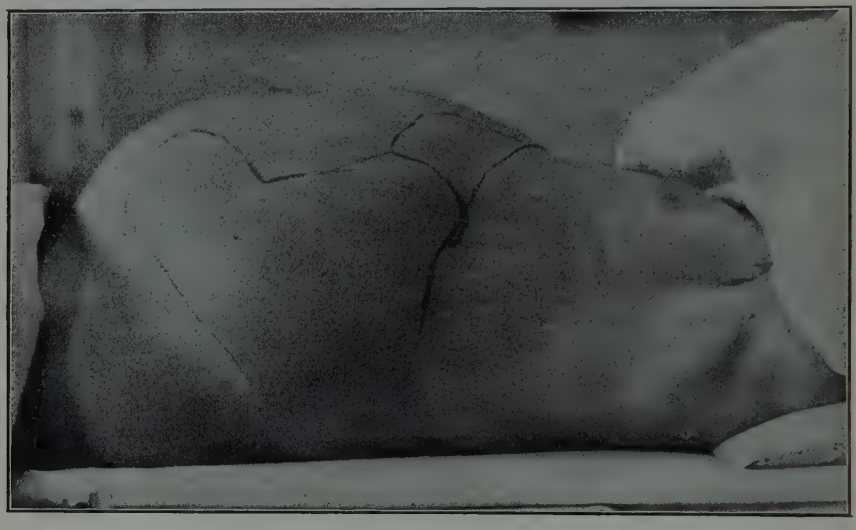

FIG. 106.—OUTLINE OF POLYCYSTIC KIDNEY AND SPLEEN.

Duration eight years; death six months later. Right kidney and liver also involved.

to distinguish congenital cystic degeneration from that which occurs in adults, but there is no foundation for this distinction. *The condition is always bilateral.* Among sixty-two cases collected by Lejars only one was unilateral, and even in that one there was a single small cyst in the opposite kidney. Another peculiarity of the disease is the frequency with which the liver is involved. Of Ritchie's eighty-eight cases eighty-six were bilateral, the liver was cystic in twenty-one, and the thyroid gland, the uterus, and the ovary each cystic in one case.

Pathology.—The most striking feature of the fully developed cystic kidney is its size. The organ grows so large as to fill the entire lumbar region and to project anteriorly almost to the median line (Fig. 106). The disease usually progresses more rapidly upon one side than upon the other, so that one kidney may be so much enlarged as to form a visible abdominal tumor, while the other cannot be palpated. The largest record specimen weighed 16 pounds (Hare).

Apart from its size, the most striking characteristic of this growth is its irregularity of surface. When the kidney has grown to such a size as to cause a surface tumor, palpation reveals the existence over the growth of larger or smaller rounded lumps, some hard, some elastic, and some even fluctuating. This characteristic irregularity of surface is all but pathognomonic of cystic disease of the kidney.

On section the cystic kidney shows an infinite number of cysts of varying sizes. With the naked eye it may be impossible to detect any normal renal tissue. The contents of the cysts are liquid, viscid, colloid, or caseous. They are usually amber-colored, rarely dark and hemorrhagic, and exceptionally suppurating. The cyst contents are not urinous, and the cysts do not communicate with the sinus of the kidney. Calculi are rarely found in the cysts, or in the kidney pelvis.

Symptoms.—The symptoms of the disease are habitually those of chronic interstitial nephritis, and, unless the tumor grows to such a size as to attract attention, the disease runs its course and terminates as chronic nephritis. The urine is albuminous and contains casts. There is polyuria. There may be no rise in blood-pressure.

The surgical symptoms are hematuria, which occurs in 25 per cent of all cases (Newman), tumor, and pain. Pyuria and fever from secondary infection are uncommon.

The course of the disease is slow. Morris estimates the expectation of life at from one to ten years, although Ritchie has recorded a case living twenty-two years after the diagnosis had been made.

Diagnosis.—According to Morris, the tumor is discovered during life in 25 per cent of cases, and about 50 per cent complain of symptoms closely resembling those of chronic interstitial nephritis. When there is hemorrhage, pain, or pyuria and slight enlargement of the kidney this is likely to suggest one of the surgical diseases of that organ.

Palpation of a large polycystic kidney through a thin abdominal wall reveals the outline of a very large kidney on the surface of which the cysts can be distinctly felt. The opposite kidney may be impalpable, only slightly enlarged, or as big as its fellow. The patient is anemic, lean and the renal function is impaired. The blood-pressure is often low, but may be increased from blood nitrogen retention.

The pyelogram proves the mass to be of renal origin and may distinguish the polycystic kidney from other forms of renal tumor. The characteristic pyelogram of polycystic kidney (Fig. 107) shows a great lengthening of the calices and irregular distortion of their extremities. Two facts help eliminate solid tumor. The pelvis of the polycystic kidney is distorted throughout in contrast to the pelvis of the cancerous kidney in one end of which normal calices can usually be found. Furthermore, tumor is unilateral, polycystic disease bilateral. Hence in doubtful cases the opposite kidney should be pyelogrammed.

Treatment.—Polycystic kidney is not a surgical disease. The patient may seem more comfortable after Rovsing's operation of multiple puncture of the cysts, but the improvement is doubtless psychic and surgery is a clumsy instrument for psychotherapy. The operation has been advised for the relief of the discomfort due to the size of the tumor. I have twice performed the operation for this purpose and, though the patients stood the procedure remarkably well, it seemed to give them no relief.

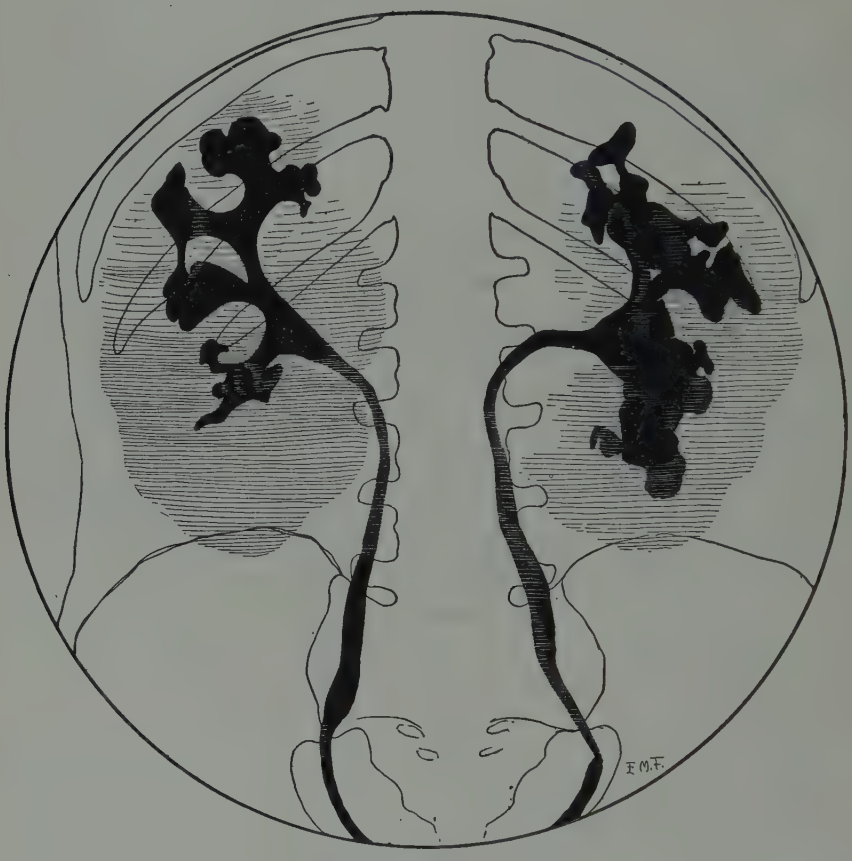

FIG. 107.—POLYCYSTIC KIDNEYS.

The plate is a composite of two urograms—one of the right kidney, one of the left—with an interval of a week between. Note great lengthening and distortion of calices.

The real justification for operation is suppuration in the cysts. This keeps up a chronic sepsis that can only be relieved by nephrectomy. The one patient upon whom I have performed this operation has survived four years but of late has shown some pyuria and complained of pain in the region of the remaining kidney. He is a physician and thoroughly alarmed. His blood chemistry and blood-pressure remain normal.

Hematuria is no indication for operation. I have removed one kidney for the relief of a perirenal hematoma. Within three months the patient returned to the hospital with a perirenal hematoma on the opposite side.

Echinococcus Cysts.—Echinococcus cysts of the kidney are rare. Houzel [2] collected the statistics of Finsen (Iceland), Thomas (Australia), Neisser, and Davaine, a total of 2,111 cases of echinococcus cysts in men, with only 115 instances (5 per cent) of renal echinococcus. Exceptionally the renal cysts are the only ones found. Usually renal echinococcus is secondary to the disease in the liver.

The cyst arises in the cortex of the kidney and grows slowly, without producing symptoms, until it reaches such a size as to form an obvious tumor, or ruptures. When left to itself the cyst habitually bursts into the pelvis of the kidney, and its contents are discharged with the urine. This occurs in fifty-two of the sixty-three cases collected by Roberts. In three of these cases the cyst ruptured into the intestines as well, once into the stomach, once into the lung; and of the eleven remaining cases eight did not rupture, two were incised, and one burst into the lung only. In only eighteen of these cases was the tumor distinguished during life. Suppuration of the cyst may occur after it has ruptured. The results of rupture are not necessarily good. The cyst may for years continue to discharge without ever emptying itself.

The symptoms are lumbar tumor, growing slowly, with little fever or pain, and no constitutional symptoms. The tumor itself simulates a hydronephrosis, and the hydatid fremitus can rarely be obtained. Later in the disease rupture of the cyst is betokened by a renal colic and followed by the discharge of hydatid vesicles through the urethra.

Treatment.—Twenty of Roberts's cases recovered and nineteen are known to have died. The only treatment of the disease, and often the only means of making a diagnosis, is nephrotomy. After the cyst has been incised and thoroughly washed out a cure may be expected. It is scarcely necessary to excise the entire cyst, and in a number of these cases nephrectomy has proved fatal.

Dermoid Cysts.—Baldwin [3] has collected seven reported cases of renal dermoid cysts.

TUMORS OF THE KIDNEY

Benign tumors of the kidney are extremely rare. The commonest of them is the small adenoma. True lipoma and fibroma have been described.

These benign growths have no clinical features. They do not give rise to any symptoms and the diagnosis is only made postmortem. Their sole interest lies in the fact that most of them are liable to malignant degeneration.

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[2] *Rev. de chir.*, 1898, xviii, 689, 811. *Cf.* also Carta-Mulas, *Gas d. Osp.*, 1915, xxiv, 609.

[3] *Surg., Gynec. & Obst.*, 1913, p. 219.

Malignant Growths

Nine cases of primary renal tumor were recorded in 4,505 autopsies. Secondary deposits were found in the kidneys ten times in 126 cases of carcinoma, and ten times in 69 cases of sarcoma. While these secondary deposits are commonly bilateral the primary malignant disease is habitually unilateral. Renal growths are about equally frequent in the two sexes and on the two sides. The distribution of the disease throughout life is rather striking. Küster has tabulated 422 cases as follows:

From birth to 5 years	128
6 to 10 years	41
40 to 50 years	125
Over 50 years	128

Thus the malignant tumors of the kidney may be considered clinically as the tumors of childhood and those of adult life. In childhood they are most common from birth to the fifth year, exceptional after the tenth year. In adults they occur most commonly between the forty-fifth and the sixtieth year.

The malignant tumors of the kidney may be divided pathologically as well as clinically into two age groups, viz., the embryomata (Wilms's tumors) of childhood and a variety of tumors, chief among which are the so-called "hypernephromata" of adult life.

Embryoma

The renal tumors of childhood were usually spoken of as sarcomata, adenosarcomata or mixed tumors until properly classified by Wilms.[4] These tumors, like most other malignant growths, remain relatively incapsulated within the kidney, so that one usually finds portions of renal tissue uninvolved in the growth even after this has reached 20 pounds' weight. Like other embryomata these growths are mixed in character, and, while sarcomatous elements predominate, especially in the large tumors, areas resembling carcinoma and bits of enchondroma, osteoma, etc., can be found in the growth unless these have been overrun by the more malignant tissue. These growths extend by lymphatic continuity into the perirenal tissue and by venous metastasis. They reach an enormous size (Fig. 108).

Malignant Tumors of the Adult Renal Parenchyma

The micropathology of the solid malignant tumors of the kidney is extremely confused and confusing. The clinician need not take sides in a purely pathological discussion. He must recognize, however, that there is a considerable difference in the clinical malignancy of these tumors as shown by the

[4] *Mischgeschwuelste der Niere,* Leipzig, 1899.

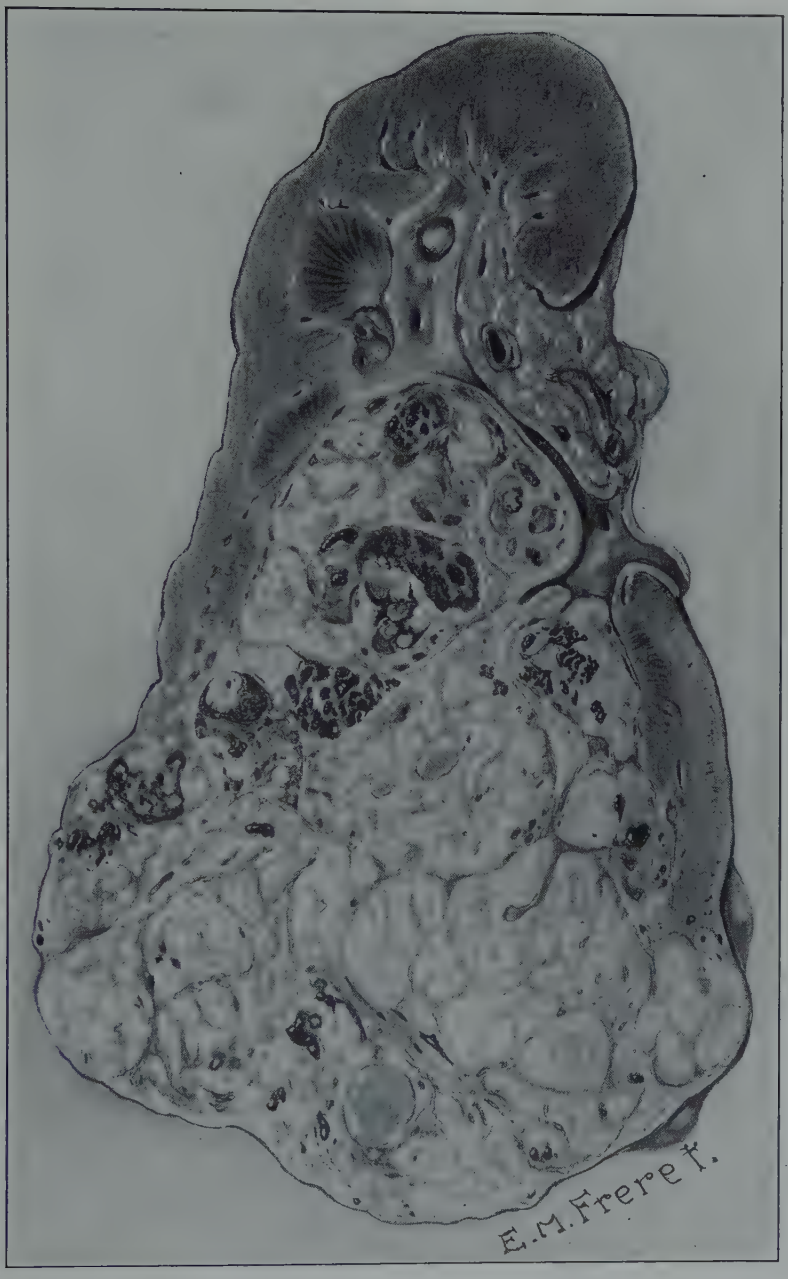

PLATE XX.—HYPERNEPHROMA.

rapidity with which they spread throughout the kidney itself and to the surrounding tissues. They are all carcinomatoid in type and, like the embryomata, tend to invade the surrounding tissues, form metastases and kill the patient before invading the whole of the kidney itself.

In accordance with their prevailing cellular characteristic these tumors are described as hypernephroma, papillary cystadenoma, papillary adenoma, adenocarcinoma. For our purposes it is sufficient to distinguish the hypernephroma—a tumor whose large clear cells resemble the cells of certain adrenal tumors whence the erroneous name, hypernephroma (Plate XX), the cystadenoma, the adenocarcinoma, without prejudice to any pathological opinion that these may be identical tumors or that there may be many other forms of malignant renal tumors. The above classification will suffice to represent for us a general gradation of local malignancy. The clear-celled tumors are the slowest to grow and give on the whole a better prognosis in that they are slower to reappear locally or as metastases. At the other extreme, the frank carcinoma invades the kidney and surrounding tissues so rapidly that an operative survival of a year or two is all that may be expected.

FIG. 108.—EMBRYOMA OF KIDNEY.

The tumor has ulcerated through the abdominal wall. It accounts for approximately half the child's body weight.

Braasch believes that the pyelogram may be taken as a diagnostic and prognostic indicator, in that the clear-celled tumors distort the calices rather than the pelvis, and are confined much more closely to one portion of the parenchyma.

The tumor invades the large renal veins early and embolic metastases occur to various parts of the body. At operation it is not uncommon to find involvement of the renal vein, the tumor extending into the cava. Exceptionally, as in Figure 110, the tumor extends from the cava to the opposite kidney. Metastatic involvement of the opposite kidney has also been noted a few times.

If the orifice of the spermatic vein is obstructed by tumor, a large painless varicocele develops rapidly.

Sarcoma of the kidney is rare and not to be distinguished clinically.

Symptoms.—The classical triad of symptoms consists in hematuria, renal tumor and renal pain. Hematuria is the characteristic symptom of renal tumors in the adult. A typical tumor bleeding is spontaneous both at its onset and at its termination. It is profuse to the extent of clotting and if very free, the blood may pour into the urinary channels in such quantity that it reaches the bladder in sufficient quantity to clot there and give the impression that the bleeding is vesical. The bleeding is painless except in so far as clots may excite renal colic or bladder spasm.

FIG. 109.—TUMOR OF KIDNEY.
The costal margin, the iliac crest and the tumor are outlined.

The intervals between bleedings are perhaps months at first, though they grow shorter as the tumor invades more and more of the pelvis.

The character of the hematuria is calculated to make the patient defer operation. The patient thinks himself in perfect health when he is horrified to perceive that his urine has become a torrent of blood and clots. He rushes to the nearest drug store and buys a bottle of pink medicine, or he calls his physician who realizes that the nervous crisis must be first controlled and so gives a pill with the assurance that the bleeding will stop. And behold! thanks to the pink medicine or the pill, the next morning the bleeding is distinctly less. In a day or so it is gone. "Let us praise the makers of pills and avoid those terrifying cystoscopists until she bleeds again; that will be a few months to the good anyway," thinks the benighted victim.

Hematuria is the initial symptom in most cases. *Pain* in the loin usually occurs later. *Tumor* may often be recognized at the time of the first examination, but is not an early subjective sign in adult life. But the embryomata are slow to form papillary outgrowths in the renal pelvis and hence it is the rule that these tumors of childhood are first noted by the tumor in the loin.

Israel [5] noted the existence of fever, intermittent or relapsing, in eighteen cases of renal or adrenal tumor. This, however, may be an early and misleading symptom.

Diagnosis.—A profuse, total, painless hematuria is usually caused by tumor. By total we mean that the urine is all bloody; the hemorrhage is neither initial nor terminal. Spontaneous bleeding so free as to permit clotting is even more characteristic. The only other hematuria that resembles it is the initial hemor-

[5] *Deutsche med. Wchnschr.*, Jan. 12, 1911.

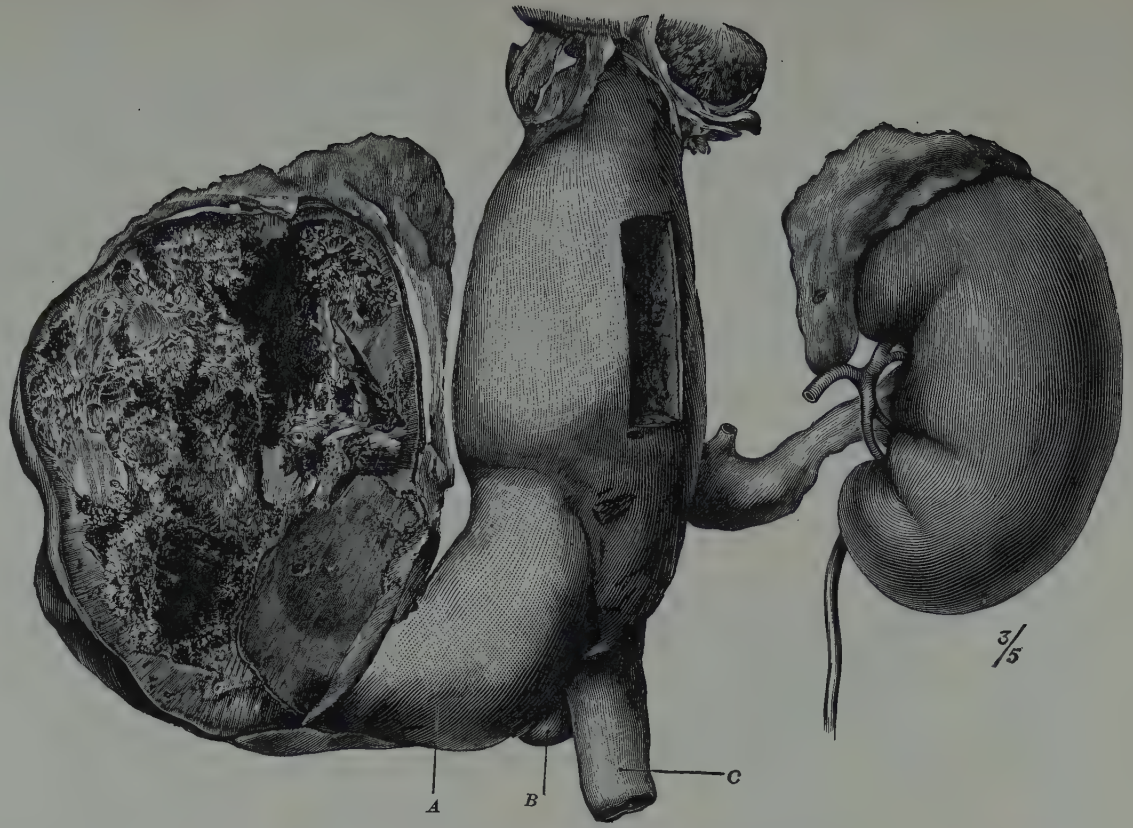

FIG. 110.—TUMOR OF KIDNEY INVADING THE VENA CAVA.

A, tumor filling renal vein; *B*, enlarged gland—in the characteristic position, the groove between cava in front and aorta behind vena; *C*, vena cava.

rhage of renal tuberculosis. This is rare and usually occurs in early adult life, at a time when tumors are infrequent.

Spontaneous varicocele in middle life is also a sign of retroperitoneal tumor, probably renal.

Loin pain, loin tenderness, loin tumor are not characteristic, at least until the patient is beyond all help.

The diagnosis is made by pyelogram, and if we are to do the patient any good by operating, it must be made while the renal function is so little impaired that no dependence can be placed upon impairment of function as a confirmatory sign. As a matter of fact, the tumor may be quite palpable and yet the renal function not appreciably impaired.

FIG. 111.—PYELOGRAM OF KIDNEY TUMOR.

The lowest calices are normal. The calix immediately above these is misshapen and, with the obliteration of the middle calices and the intrusion of tumor into pelvis at this point, outline the tumor. The upper major calix is dilated and distorted. The minor upper calices are almost obliterated.

Unfortunately we still continue to see children so late that the tumor alone is the usual diagnostic sign. But the embryoma is slow to invade the surrounding tissues or to form metastases. Enormous tumors have been removed from children successfully.

Simple radiography may show the tumor and occasionally will reveal streaks of calcification in it, similar to those seen in tuberculosis.

The barium enema shows displacement of the colon downward and inward if the tumor is large.

Braasch (and Carman [6]), has, out of his unequaled experience, classified the deformities due to renal and renal pelvis tumor, as shown by pyelography. There are:

Changes in the calices (Figs. 111, 112); usually elongation, irregular narrowing, incomplete filling, with shortening, obliteration, deformity, especially at the tip, accompanied with:

Changes in the pelvis; filling defects, distortion.

Displacement of the kidney, angular, rotary, total.

In discussing these changes from the point of view of differential diagnosis one must mix the following items, as Whistler did his pigments, "with brains."

Congenital abnormality of the kidney pelvis (Plate V) does not show filling defects. Elongation of the calices is rather generalized than localized. The calices are not pinched at one end of the kidney as compared with the other. The calices are not distorted, though they may look so. The deformity is bilaterally symmetrical.

[6] *Radiology*, June, 1925. *Cf.* also Braasch, *Pyelography*.

Polycystic kidney is bilateral. All the calices are lengthened. Their terminations are dilated rather than obliterated. The pelvis may be cylindrical or oval. The vertical diameter of the pelvis is likely to be increased (Fig. 107).

Simple large cyst gives local obliteration or blunting of calices, displacement of kidney.

Extrarenal tumors displace or rotate the kidney and angulate the ureter; and an intrarenal tumor may also do this.

Blood-clot or stone are mobile, as seen on repeated pyelograms.

Pelvic tumor deforms the pelvis rather than the calices. It dilates the pelvis by obstructing the mouth of the ureter. It may give secondary tumors in the bladder, which parenchymal tumors do not.

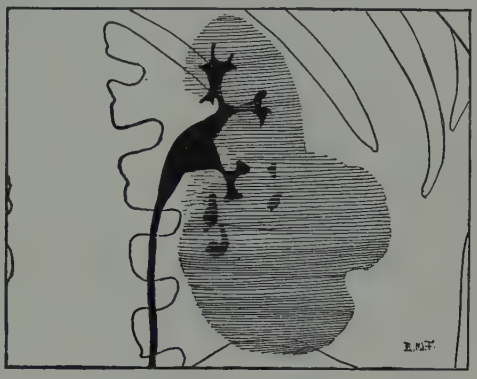

Fig. 112.—Pyelogram of Kidney Tumor.

The lower major calix is narrowed, its minor calices distorted and lengthened, their necks so narrowed that they seem entirely separated from the major calix. The irregular shape of the tumor is seen. This tumor should prove less malignant than the one depicted in Fig. 111, for it is more localized and peripheral.

Treatment.—The treatment of renal tumor is nephrectomy, if the opposite kidney will support life. Radiation is singularly inefficacious. Relapse locally or by metastasis is very common. It may occur late. One of my patients whose kidney I removed, leaving a tumor in the renal vein, was well for four years and then dropped dead. Another, apparently cured for eleven years, then died of tumor of the brain.

The mortality of operation is no more than 10 per cent, though the failure to remove the kidney because of adhesions doubles this figure. If the operation is properly performed, hemorrhage is no excuse for failing to get the kidney out.

Epithelial Tumors of the Renal Pelvis and Ureter

The primary tumors of the renal pelvis are epitheliomata, sessile or papillary in type. Hunt[7] has found in them the same characteristics we note in similar tumors of the bladder. There were eight sessile tumors to fifteen papillary. The sessile tumors grew as single ulcers, extending to the surrounding tissues but not multiple, not spreading by surface contact. They were more malignant than the papillary tumors. Two died in hospital, five within six months of nephrectomy, one of metastasis after three and a half years.

The papillary tumors tend to multiplicity, usually begin in the kidney pelvis and spread down the ureter to the bladder. A few primary epitheliomata of the ureter have been reported. I have a patient who has had bladder tumors of

[7] *J. Urol.*, 1927, xviii, 225.

low malignancy controlled for ten years, who now, in her eightieth year, has begun to bleed from her right ureter. Of Hunt's fifteen cases six seem well. Nine of the fifteen showed extension to the bladder, half of them after nephrectomy. One of my cases had a tumor of the right side of the bladder after the removal of which papillary tumor of the left kidney pelvis was discovered, but the bladder tumor is usually precisely on the orifice of the ureter from which the tumor descends.

At the Mayo Clinic in seventeen years 318 malignant tumors of the kidney were removed, of which 23 (7.2 per cent) were epitheliomata of the pelvis.

Diagnosis.—All of Hunt's cases showed hematuria as the predominating symptom. Five of them showed renal enlargement due to hydronephrosis. Five had tumor of the bladder at or near the ureter orifice. The youngest was thirty-four, the oldest sixty-five, the average age fifty-one. The average age of Foulds' 249 renal tumors in adults was fifty-two.

The diagnosis is made by pyelogram.

Treatment.—The treatment of sessile tumor is nephrectomy, of the papillary tumor ureteronephrectomy. The ureter should be removed as far down as convenient with the kidney and at a subsequent operation the lower end of the ureter is removed together with the bladder wall surrounding the ureter orifice.

Yet in the absence of recognizable tumor at the lower end of the ureter the patient may rebel at the second operation. Thus only eight of the fifteen papillary tumors reported by Hunt submitted to complete ureterectomy, only four to removal of the bladder cuff. Three of these patients died of bladder recurrence following late ureterectomy. Of five whose ureters were not completely removed three died of recurrence. In two recent cases Hunt did complete nephro-ureterectomy in one operation.

CHAPTER XXXVII

TUMORS OF THE BLADDER; TUMORS OF THE URETHRA

YOUNG classifies primary bladder tumors as follows:

I. Tumors of adult tissue

1. Organoid

(*a*) Epithelial:
Adenoma, solid or cystic

(*b*) Mesothelial:
Hemangioma

2. Histoid

(*a*) Epithelial:
Papilloma
(Malignant papilloma)
Papillary carcinoma
Adenocarcinoma
Epithelioma, squamous or basal cell

(*b*) Mesothelial:
Sarcoma, round-, spindle- or giant-cell
Fibroma
Lipoma
Leiomyoma
(Lymphosarcoma)

II. Heterotopic tumors

Embryoma:
Dermoid cyst
Teratoma
Rhabdomyoma
Chondroma
Myxoma

III. Extravescial tumors

Retrovesical sarcoma
Retrovesical hydatid cyst

Clinical interest centers about the epithelial tumors. They constitute fully 90 per cent of our clinical cases. Adenoma is extremely rare and apparently benign. Adenocarcinoma is usually secondary, due to invasion of the bladder by an adjacent adenocarcinoma of the gut, almost always by the sigmoid or rectum, the uterus or the prostate. Yet islands of gland tissue occasionally occur in the bladder and give rise to the very rare primary adenocarcinoma. Imagine my astonishment when, after the successful removal of a bladder diverticulum, the pathologist reported the tissue as intestine! I have seen one sarcoma of the bladder and one tumor that the pathologist had to cut to pieces before he discovered the bit of typical adenocarcinoma that decided the true character of an apparently sarcomatous growth. I have seen two myomata, solid growths of no great size, one hemangioma, mistaken clinically for a papillary carcinoma, and two cases of bleeding bladder varix.

EPITHELIAL TUMORS

The epithelial tumors of the bladder are scientifically classified as above. The clinician recognizes them under the names, papilloma, malignant papilloma, papillary carcinoma and infiltrating carcinoma, which nomenclature corresponds quite accurately to the 1, 2, 3, 4 classification of Broders. I agree with the many authorities who object to the hybrid term "malignant papilloma." Yet there are not a few tumors generally papillary in type that show here and there irregularities of cell and nuclear outline as well as epithelial penetration of the connective tissue framework suggesting a mild degree of malignancy (Broders' type 2) which stand in an intermediate place between the papilloma and the papillary carcinoma. One thinks of them quite properly as "of doubtful malignancy."

The histology of bladder tumors needs no repetition here. But the student must remember that the tumors do not always remain true to type. At the two extremes of malignancy one does encounter tumors true to type. One of my patients bled for thirty years from a papilloma that was still a pure papilloma when I removed it. The primary infiltrating growths recur true to type. But in between, there is every variety. One sees areas of definite unmistakable carcinoma in tumors otherwise purely papillomatous, and oftener still the minor suggestions "of doubtful malignancy." When the tumors are multiple some of them may be purely papillary, others papillary carcinoma. Recurrences may show a different degree of cellular malignancy from that of the original tumor, the recurrence being more or less malignant than that of the original tumor.

The tentative antemortem classification of epithelial bladder tumors is actually the following:

Papilloma.—Tumor single or multiple. The tumors are usually multiple when first seen. The later in life the tumor occurs and the more numerous the tumors the more likely are they ultimately to prove malignant; *i.e.*, to develop into or recur as papillary carcinoma.

Papillary carcinoma, including the tumors of doubtful malignancy—Broders' types 2, 3, 4—tumors usually multiple, though the more malignant tumors with infiltrating base often overshadow the small papillary tumors about them. The least malignant of these tumors clinically resemble papilloma, high growing masses of fleshy fronds with small base. More malignant are tumors that spread like a patch of grass, low fronds not collected on a stalk but each growing from a separate pedicle. More malignant still are the tumors with palpable infiltration of the bladder wall or with spontaneous surface ulceration due to interference with the blood circulation within the tumor by dense cellular infiltrations within it. Of equal malignancy are the lobulated polypoid growths that look quite hard and solid but are revealed by the microscope to be papillary carcinomata (Fig. 115).

Papillary secondary growths usually appear first as contact inoculations of surfaces that are opposed as the bladder empties. Tumors secondary to papillary growths of the kidney pelvis and ureter usually first appear on the lip of the ureter. Papillary tumors spread to the posterior urethra but very rarely to the anterior urethra.

Fig. 113.—Papillary Carcinoma of the Bladder. The clinical malignancy of such a tumor depends upon the infiltration of its base.

One might recognize as a special class those tumors, usually of low individual malignancy, but twenty or more in number, spread all over the bladder vault like a crop of warts. Or again one might classify apart those that relapse in different parts of the bladder year after year, or after an interval of many years. For instance, a recent patient had a single tumor removed by fulguration in 1914; bleeding recurred in 1927 and two treatments sufficed to burn off his one small tumor. Another was relieved by resection for papilloma in 1918; bleeding recurred in 1923; various tumors were burned off until 1927, when she began to bleed for the first time from the right ureter. But it were mere casuistry to classify such cases apart.

Primary Infiltrating Growths.—These are the scirrhus, squamous and adenocarcinomata of Geraghty's classification. The growth is single. It is not papillary. It begins as a redness and swelling of the mucosa. The tumor breaks through the surface of the mucosa as a carcinomatous ulcer. This spreads both in depth and superficially as an ulcer with raised hard edges, the

granular base of which may simulate papillary carcinoma, but is actually a pulpy mass, sloughing in places. Like the "sessile epithelioma" of the kidney pelvis it does not make contact growths, but eats away the adjacent tissues.

Metastasis and Spread by Direct Invasion.—The incredible advance that has occurred in the curability of bladder tumors of late years is due to radiotherapy, but is made possible by the slowness with which these tumors spread either by metastasis or by direct invasion. It is all very well to quote the findings of Albarran, viz., metastasis found in eleven among seventeen cases of bladder tumor examined postmortem. But these patients were dead and therefore by definition of no further prognostic interest. The clinician may be consoled by the fact that bladder tumors do not kill by metastasis as often as by

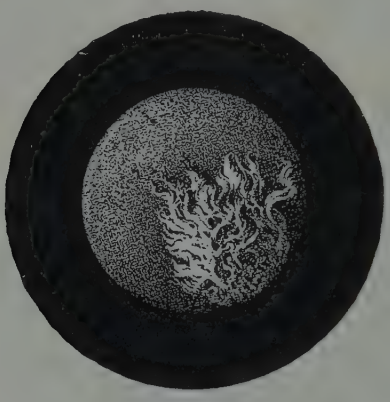

FIG. 114.—PAPILLARY CARCINOMA.

If the base of this tumor is not palpably infiltrated it is one of relatively low malignancy. (Albarran.)

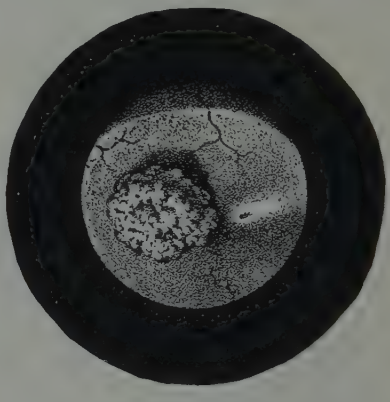

FIG. 115.—"LOBULATED" CARCINOMA.

Actually a papillary carcinoma of relatively malignant type. (Albarran.)

local action, the pain of cystitis, the destruction of kidney function by blockage of the ureter, the tumor toxemia.

As our treatment of tumors of the bladder becomes daily more efficient, I look forward to the unhappy moment when a patient of mine, cured of his bladder lesion, shall die of metastases. A few such have already been reported.

Implantation.—The primarily infiltrating tumors do not spread over the mucosa by surface implantation. The papillary tumors do. This is often a contact implantation. Having discovered several tumors in one side of the bladder, it is interesting to let the water out until the descent of vault and lateral walls brings the tumors in contact one with another.

Papillary tumors also jump from one side of the bladder to the other and spread about indiscriminately in the bladder. In the urinary tract at large they seem to spread only down stream, *i.e.,* from kidney pelvis to ureter, from ureter to bladder, from bladder to posterior urethra. The only exception to this rule that has come under my observation is mentioned in reference to tumors of the kidney pelvis.

Site of the Original Growth.—The favorite site for the original bladder tumor is on the mobile part of the bladder not far, as measured cystoscopically, from the ureter mouth. Ulcerating growths may originate on the trigone. Papillary growths do not until they have multiplied within the bladder. A papillary single growth on the trigone or actually at the ureter orifice is secondary to tumor of the renal pelvis.

But a certain reticence may be felt in classifying the precise favorite location for bladder tumor. There is no question but that most of them are in the lower half of the bladder. Thus Young's chart of 209 bladder tumors shows only

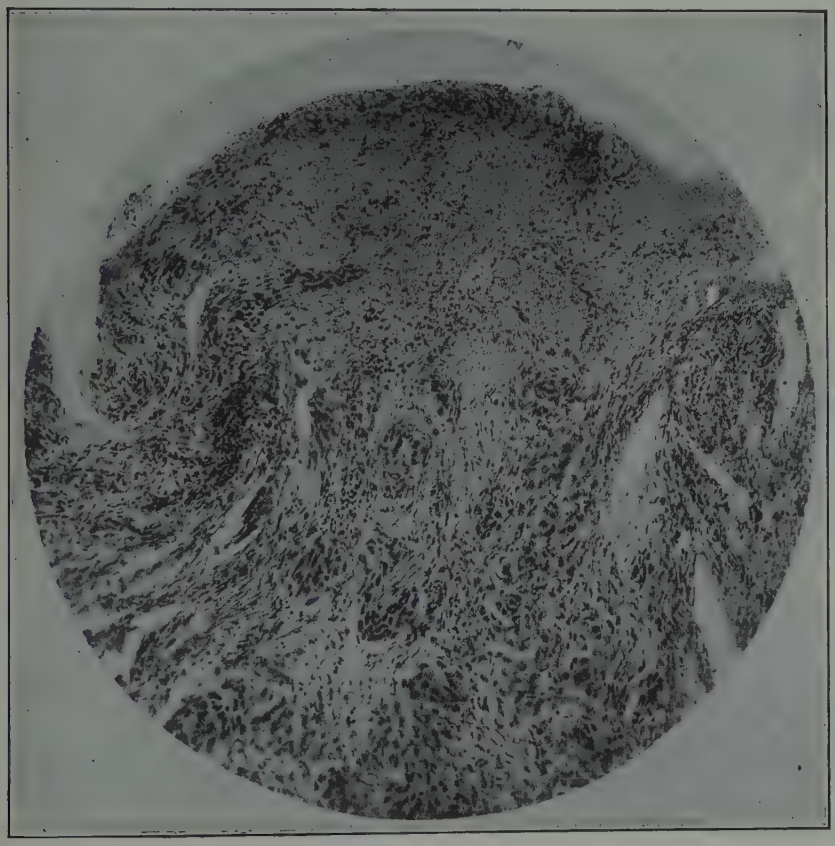

FIG. 116.—CARCINOMATOUS INFILTRATION BENEATH APPARENTLY NORMAL MUCOSA.

36 in the upper half of the bladder, only 11 on the subperitoneal portion. But the cystoscopist sees the tumors much nearer the ureter orifices than they really are. When he comes to burn them with the cystoscopic electrode, or to search for them after opening the bladder suprapubically, he is surprised to find how far up the fundus or the lateral wall they are.

Secondary implantation of papillary tumor upon the trigone is not uncommon.

Symptoms

Hematuria of the tumor type has been considered "the first, the last, almost the only symptom" of bladder tumor. But unfortunately hematuria is not an early symptom of tumor. The papillary tumor does not bleed until it has grown large enough to be pinched by the bladder as it empties, or to be caught in the grip of the sphincter. The infiltrating tumor does not bleed until it has been present some time as an ulcer. At the first hemorrhage the infiltrating tumor may be found inoperable. Hence we must pay closer attention to the less dramatic symptoms. But hematuria is the dominant note of the clinical picture.

Yet it is the initial symptom in less than three out of four of the more malignant tumors. Combining Geraghty's [1] and Albarran's statistics we find hematuria the initial symptom of papilloma in 119 out of 129 cases, over 90 per cent; but in only 129 out of 183 carcinomata, 70 per cent. In the others the initial symptom was some disturbance of the bladder function, a frequency of urination or dysuria, a cystitis, a retention. Such cases are familiar. The patient suffers from mild bladder irritation, for a time, then from cystitis, with or without retention; but he consults no physician until hematuria drives him to it. He then is found to have an extensive carcinoma.

The characteristic hematuria of neoplasm, whether renal or vesical, begins without cause or warning, continues copious and painless, unaffected by rest, diet, or medication, and ceases, as it begins, without apparent rhyme or reason. Its cessation may leave the urine entirely normal and the patient lulled into a false sense of security by what he considers his happy escape from a perilous condition. A profuse hemorrhage of this character is almost pathognomonic of neoplasm. Yet bleeding from a tumor may not be characteristic.

If the tumor is of the gravest type the patient is sufficiently sick at the time of his first hematuria to seek medical advice and obtain a cystoscopic diagnosis soon thereafter. But if his tumor is papillary his first bleeding may stop before he has the courage to consult a physician. To his joy he finds himself as well as ever. If he bleeds again after a few months he will deliberately delay until the bleeding again stops. Thus the months and years pass until a terrifying hemorrhage brings him to terms. Such a hemorrhage may result in acute retention by filling the bladder with clots too large to pass through the urethra.

I have seen several papillomata the only symptom from which was the frequent and painful urination of cystitis. But cystitis is usually a late complication, not infrequently due to cystoscopy, for the tumor itself may harbor bacteria while the remainder of the bladder is free from infection until the trauma of cystoscopy excites this.

As they grow large, papillary tumors may obstruct urination. Infiltrating tumors are more likely to obstruct one or both ureters.

[1] Cabot's *Modern Urology*, 1924, ii, 224.

Several of my patients with papillary tumors have complained of referred pain of considerable severity in the sacro-iliac region. Their bladders were uninfected; their pain was immediately relieved by the destruction of the tumor.

The progress of the disease after infection has been established is rapidly downward, a death of torture unless the tumor is removed, for the cystitis of tumor is peculiarly intractable.

Diagnosis

The age of the patient gives a clew. In infancy and early years bladder tumors are myxomatous or sarcomatous. Koll has reported a papilloma in the bladder of a child a year old. Yet among Geraghty's 162 tumor cases the youngest bearer of papilloma was aged fifteen and there were but five other papillomata, and no carcinomata, registered below the age of thirty. I have seen one infiltrating carcinoma in a girl of twenty-three, a papilloma in a man of seventy-two, a tumor that behaved clinically like a papilloma in a woman of eighty-two. But carcinoma is rare below forty, papilloma rare above sixty. Geraghty places 78 per cent of his papillomata between the ages of thirty and sixty; 68 per cent of his carcinomata between fifty and seventy.

The diagnosis of infiltrating tumor may be made by the history, the peculiar stench of the infected bloody urine—an even deader smell than that of some phosphatic stones—and the hard mass revealed in the pelvis by bimanual examination.

At the other extreme, tumor may be suspected from the presence of a few blood-cells in the urine, an unaccountable bladder irritation, or the accidental discovery by rectal touch of a mass involving the bladder base.

But precise diagnosis always requires cystoscopy. Indeed, without the cystoscope diagnosis is impossible in the majority of cases. Cystoscopic diagnosis covers three points: The presence of tumor, the distribution of tumor, the character of the tumors. The presence of complicating infection, stone, incrustation, prostatic retention, etc., are inevitably observed.

Note particularly that the mere discovery of a tumor in the bladder and then withdrawal of the cystoscope is drama, not diagnosis. If the tumor is not papillary, one suffices. But if it is, there may be tumors in the urethra—and their presence should be suspected if there has been urethrorrhagia, bleeding independent of urination, or if this follows cystoscopy; or of the kidney pelvis (which may be diagnosed by pyelogram) if the bladder tumor is at the lip of the ureter or if the kidney function is impaired. There may be tumor of the cystoscopic "blind-spot."

At the first cystoscopy the visible tumors in the bladder at least should be charted. Subsequent urethroscopic examination will cover the urethra and the blind-spot.

The cystoscope may leave one in doubt as to the presence of tumor in the

bladder under two conditions: in the first place, when the tumor is too small; in the second, when it is too large.

The small pedunculated tumor, especially if situated in an unusual part of the bladder, may entirely escape the cystoscopist. I have once overlooked a bladder tumor of this character; indeed I have seen an infiltrating carcinoma of the bladder vault the size of a trade dollar that had eluded two cystoscopic examinations. The mistake can usually be avoided by careful observation of the region where the bladder tumors usually grow. These are:

1. The regions about the ureter orifices, especially just beyond and outside of them.
2. The vault—where carcinoma is not uncommon.
3. The bladder neck and that part of the vault just above this as well as the adjacent portions of the deep urethra.

The large tumor is difficult to diagnose by the cystoscope, not on account of its size, but because of the severe cystitis with which it is often accompanied. Cystoscopy may be impossible without caudal anesthesia, or if performed, may reveal a bladder that will hold but a few teaspoonsful of urine, and the walls of which are intensely inflamed, and covered with phosphates, or slough. Under these circumstances, one may well remain in doubt as to whether one is dealing with a carcinomatous growth, an incrusted simple ulcer, or a stone covered with slime and blood. A decision may be reached by tapping the "stone" with the end of the cystoscope, and by excising a specimen with the cystoscopic forceps.

The cystoscopic forceps is used as a routine measure by some operators for the diagnosis of the exact nature of all tumors of the bladder. There seems to be no unanimity among pathologists as to whether this practice is dangerous or not. It is certainly no danger when there is already ulceration of a growth. But if the pathologist, with the whole tumor in his hand, cannot say whether it will recur as a carcinoma or a papilloma, he certainly cannot do so from the small specimens that can be removed by forceps.

The cystoscopist should endeavor to make his diagnosis of malignancy on the clinical features of the tumor as revealed to the cystoscope. This he can usually do with almost absolute certainty. If there is any doubt in his mind, then let him by all means take specimens from the growth in order to clear up that doubt.

In the broadest sense,[2] malignancy is that characteristic in a tumor which makes it threaten life unless it is destroyed or excised. The pathologist finds that certain cellular characteristics are associated with varying degrees of malignancy, and he has taught us to appeal to him for a decision as to whether a tumor is benign or malignant, and, if the latter, as to its degree of malignancy.

But malignancy is also a clinical condition, and therefore its diagnosis may not be wholly relegated to the laboratory. There is a clinical malignancy the degrees of which do not run quite parallel to those of cellular malignancy. It

[2] Keyes, *J. Am. M. Ass.*, 1928, xc, 350.

is true that some tumors are so excessively malignant that clinic and laboratory find no difficulty in agreeing about them. Adenocarcinoma of the kidney is one of the most characteristic of these. It is utterly malignant, whether treated or untreated. This is not so true, however, of the most malignant tumor with which the urologist has to deal; viz., the malignant teratoma of the testis. Ten years ago it was almost as utterly malignant as the melanoma. To-day, the combination of radiation and operative therapy has cut its clinical malignancy almost in half.

The malignancy of the tumors of the stomach and intestines may be considered from another point of view. These are clinically excessively malignant, not because they grow with the terrifying rapidity of the melanoma or the seminoma, but because they are relatively inaccessible to early diagnosis. They often have time to grow beyond control before diagnosis is practicable. Were tumors of the same cellular characteristics to occur on the surface of the body, they would show a far lower degree of clinical malignancy.

Hence, it seems not unfair to argue for a double standard of malignancy, *i.e.*, cellular malignancy, which determines what the tumor would do if it were not treated at all, and clinical malignancy, or the amenability of the tumor to treatment.

The clinical malignancy of bladder tumors has been rapidly diminishing through the last twenty years.

Though not of cellular malignancy, bladder papillomata were slowly yet inevitably death-dealing (and therefore clinically malignant) until Nitze provided the instrument whereby they might be seen, and Beer the treatment whereby they might be cured. To-day they have passed from grave clinical malignancy into a clinical benignancy compatible with the claims of the pathologist. We no longer moan with Guyon, "We await in the clinic the papilloma of statistics." In the last ten years, only one of my patients with papilloma has died of that disease or of my attempt to cure him, and I hope not to lose another.

All other epithelial tumors of the bladder are still classified as malignant. Yet a stage of therapeutic efficiency is being reached wherein the favorite urologic methods of treatment are more and more successful year by year. The spector of malignancy is fading, as far as tumors of the bladder are concerned.

But although to-day the clinical malignancy of the more superficial and localized malignant bladder tumors is far less than was that of the papillomata twenty years ago, they are not as yet wholly conquered, and their kin, the infiltrating growth are, perhaps, as malignant as they ever were. The next step in advance will unquestionably result from the tumor register now being established by the American Urological Association, for until this register has begun to function, uniformity in the gross or microscopic diagnoses of the different varieties of epithelial tumors of the bladder cannot be expected.

Now the evidences of clinical malignancy, *i.e.*, resistance to the less radical forms of treatment are four:

1. Hardness of the tumor
2. Intractable cystitis
3. Sloughing or ulcerated tumor
4. Multiplicity and size of tumors

Hardness of Tumor.—The hardness of a vesical tumor may be appreciated in several ways. Rectal or vaginal touch may reveal an induration in the region of the trigone; bimanual palpation may disclose the presence of a large infiltrating tumor; or cystoscopy may reveal an ulcerated indurated carcinoma. All such conditions contra-indicate cystoscopic treatment.

Intractable Cystitis.—In the years since Beer introduced fulguration, I have never seen a case with intractable cystitis that was suitable for intravesical treatment. The patients suffering from relatively benign papilloma may, it is true, suffer from time to time the most intense cystitis. But this can be relieved by the ordinary bladder irrigations to the point of ameliorating the patient's suffering, and permitting fulguration.

But the real intractable cystitis is not appreciably relieved by any local application; is only intensified by the introduction of the cystoscope; permits only the most inadequate and unsatisfactory observation, and of itself almost prohibits treatment. Such a case when operated upon will be found to have either a sloughing carcinoma, or some condition other than tumor.

Sloughing or Ulcerated Tumor.—A tumor that shows upon its surface any extensive sloughing is truly malignant. However, the mere presence of small sloughs does not forbid all hope of success by cystoscopic treatment. Here, then, the contra-indication is not absolute. Let the cystoscopist, however, proceed with caution, and if a few treatments do not manifestly control the growth, let him waste no further time, but quickly have recourse to the open operation.

Multiplicity and Size of Tumors.—The contra-indication here is even less definite than that of sloughing. Multiplicity of tumors is a perfectly obvious suggestion of malignancy. Such malignancy may be of two types. The multiple papillomata either spring from an underlying carcinoma, *e.g.*, an infiltration from the cervix uteri, or are propagated by surface contact. In the latter case the malignancy is a superficial one. Indeed, a very large proportion of bladder papillomata are multiple when first seen. Yet a majority of these are certainly amenable to treatment by fulguration.

Size and multiplicity of tumors, therefore, present a problem in practice rather than in malignancy.

The cystogram (Fig. 49) with air or an opaque fluid—and I always make one of each—will delineate the more projecting tumor masses quite plainly. It should be employed as routine, but it gives no accurate knowledge of the malignancy of the tumors; it does not show small tumors or, worst of all, infiltrating tumors that are too small to be palpated. But its inaccuracies are wholly different from those of the cystoscope and are therefore useful as a check to these.

Differential Diagnosis

Inflammatory lesions of mild chronic cystitis, especially about the bladder neck, may produce a papillary cystoscopic picture. The location, the low diffuse growth, the disappearance under instillations of silver nitrate, establish the diagnosis, as a rule, though Geraghty assumes that certain cases of diffuse papillomatosis reported as cured by the curet are inflammatory. I have seen but one such case.

The reaction of the mucous membrane to cauterization, whether by diathermy, fulguration, radium or x-ray, often lasts for months and, in the case of radium, for years. Precise cystoscopic observation supported by biopsy should differentiate this from tumor. But doubtless from time to time in the future as in the past such infiltrations will be treated as carcinoma.

Grave localized patches of cystitis or ulceration secondary to pyonephrosis may be mistaken for infiltrating tumor. The discovery of pyonephrosis and the result of biopsy should establish the diagnosis.

Incrusted ulcers precisely imitate carcinoma. All incrusted bladder lesions should be treated as inflammatory until the failure of this treatment proves them carcinomatous.

Biopsy, showing adenocarcinoma, supported by the general physical examination distinguishes secondary tumors. Adenocarcinoma of the trigone is usually, though not always, secondary to carcinoma of the prostate.

Treatment of Papilloma

Fulguration through the cystoscope is the ideal treatment for papilloma. This will cure all cases that do not show enormous tumors or tumors so multiple that the patient cannot endure the repeated treatments. The large tumors are better treated by removal through a suprapubic section and implantation of radium or diathermy. Multiple papillomata by cauterization, diathermy or fulguration through a suprapubic opening.

Fulguration should never be performed under ether or ethylene anesthesia lest the spark ignite the vapor and explode the patient's lungs. This accident has occurred a number of times. The surgeons to whom such accidents occur do not publish them.

Cystoscopic fulguration may be persisted in only on condition that the case progresses favorably. If progress is not being made, or if cystitis becomes intractable, further treatment must be conducted through the open bladder. What more distressing than to see a patient whose timidity or whose surgeon's obstinacy has encouraged treatment by cystoscopic fulguration while the tumors were multiplying, the patient suffering, the malignancy of the tumor more manifest as the months rolled by. Many a life has thus been needlessly sacrificed.

Fulguration may be performed either by the Oudin or the d'Arsonval (bi-

polar) current. Beer[3] prefers the monopolar Oudin. Heitz-Boyer removes the tumors with the d'Arsonval and treats the surrounding mucosa with Oudin, sparking to prevent recurrence. Most other urologists use only the d'Arsonval. I have not used the Oudin spark in years. I have used a variety of the Wappler generators as source of electricity. The cystoscopic illumination should be obtained from a dry-cell battery so as to prevent short-circuiting.

The technic of fulgurating small tumors is simple. A blunt insulated electrode is introduced through the cystoscope and with this the tumor is burned. As the current is turned on and applied to the tumor, this turns white and a stream of bubbles ascends to the vault of the bladder. The electrode is kept in contact with the tumor for from fifteen to thirty seconds. Then the electrode is pulled away and reapplied elsewhere. The electrode sticks to the tumor and may cause a slight bleeding as it separates. This is checked by further cauterization to stop the bleeding before proceeding to burn elsewhere. The burning is continued until the patient or the operator is tired, or until the job is done.

Caudal anesthesia expedites the treatment of difficult cases. My tendency is to use it more and more. It is especially convenient as one approaches the base of the tumor, for though the tumor is insensitive the bladder wall is not.

Large or multiple tumors should always be attacked under caudal anesthesia. An effort should be made to get at the base of a large tumor by slipping the wire under it until the base is reached and lifting the tumor away from the mucosa before beginning to fulgurate.

At the close of the operation the bladder is emptied and a little 1:1,000 acriflavin solution injected as a prophylactic against infection from the bacteria in the tumor.

Fulguration is repeated not oftener than once in a fortnight. Ulcers and infiltrations of the mucosa that resemble carcinoma are disregarded and the treatments continued until all papillary growth has been removed. Then the patient is dismissed for six weeks, when a confirmatory cystoscopy is done and a minute search of the whole bladder and urethra made in order to discover tumors that may have been overlooked. The burns in the mucosa are noted and, if carcinoma is suspected, a biopsy taken and the cystoscopy repeated at monthly intervals until the infiltration has disappeared.

Confirmatory cystoscopy should be repeated in three months, then six months, then a year, then two years. If the bladder is clean at this time, four years after the beginning of treatment, he may be discharged as cured, though a few cases will relapse after a longer interval. Two of my patients relapsed after five years, one after eleven.

Apart from intractable cystitis, which may prohibit further cystoscopic fulguration, the one complication of fulguration is hemorrhage. This occurs at the time of the separation of sloughs, about two weeks after the fulguration. As it arises from the artery at the stalk of the tumor the bleeding may continue briskly enough to fill the bladder with clots, cause retention and exsanguinate

[3] *A. J. Surg.*, 1928, iv, 113.

the patient. He should therefore be warned of the possibility of hemorrhage after an interval and should notify the urologist at once. The treatment of this complication is to give a caudal anesthesia, empty the bladder of clots by the litholapaxy tube, and fulgurate the bleeding point. This accident will occur in about 5 per cent of cases. I have never known the bleeding to recur. Even though the fulguration apparatus is inaccessible where the bleeding occurs, emptying of the bladder is likely to check it. If not, the viscus must be opened and the bleeding point touched with nitric acid or the actual cautery.

Treatment of Papillary Carcinoma

Small papillary carcinomata without infiltration of the base may be cured by a good fulguration under caudal anesthesia. If there is doubt as to the malignancy of the base, one should bury one or two radium emanation platinum "seeds" at the base, each containing 2.5 mc. of the emanation. Such seeds, with instruments for their introduction, can now be supplied almost anywhere in the United States. But if they happen to be inaccessible, the bladder should be opened and the base of the tumor, to the very roots, well burned with the actual cautery.

The implantation of radium emanation seeds, whether cystoscopic or suprapubic, should be made regardless of the ureter. The effect of burning with the glass seeds that we used to use was sometimes to close the ureter in the scar and cause pyonephrosis. The metal seeds, by sparing the tissues while destroying the tumor, rather open than close the ureter.

As made to-day, the 2.5 mc. platinum seeds, with 1 mm. thickness of the metal as screen, correspond roughly in tumor destructiveness to 1.5 gold seeds with thinner walls, and when few seeds are to be used, as through the cystoscope, I prefer the platinum, though it is much more expensive. But where a large area is to be covered, as in the open operation, the expense of the platinum is so prohibitive that I have employed gold seeds; 1.5 mc. each if no more than twenty are to be used, 1 mc. for more than twenty. I have not implanted more than thirty.

The use of radium confuses the issue by leaving a burn that takes much longer to heal. The operator must learn, with the assistance of biopsy, to distinguish burn from tumor.

It is not easy to insert the radium seeds accurately through the cystoscope unless the tumor is near the trigone. If the first or second treatment does not control the tumor, the bladder should be opened for further treatment. Indeed, the beginner should make his first radium experiments with the bladder open and use it through the cystoscope only after he has become accustomed to the reaction in the tissues that follows.

If the tumors are multiple, large or infiltrating, they should be attacked by radium implantation through a suprapubic incision. Corbus reports excellent results by diathermy. General surgeons continue to do resections. But Beer,

who is singularly expert with his cautery resection, has cured cases [4] with radium that he considered unsuitable for resection. I have now done 28 suprapubic implantations of radium emanation with only one operative death, 26 of which I have reported,[5] and I am confident that suprapubic radium implantation is the simplest and safest operation for bladder tumor and that with it any one's immediate operative mortality will be lower than with any other method.

As to the permanence of radium control of bladder tumors, Barringer,[6] in some of whose work I have shared, has sufficiently established this. The radium has the advantage over any resection or cauterization, the limits of which depend upon the surgeon's judgment, that it works mathematically and in the depths of the tissues as well as upon the surface. The suture of the bladder without drainage, which I have employed whenever there was no urethral retention and the bladder was thick enough to hold, not only reduces the immediate mortality by protecting the prevesical space from infection, but also gives the patient a much more comfortable convalescence and permits confirmatory cystoscopy before the patient leaves the hospital, so that whenever recurrence occurs it may be controlled without delay by cystoscope or reoperation.

No hemorrhage or other complications have arisen as a result of this immediate suture of the bladder.

My results with this technic to date are:

Type	Cases	Radium		Postoperative Cystoscopic		Operation Repeated	Under Treatment	Controlled	Deaths
		Operation	Cystoscopic	Burn	Radium				
Papilloma	8	4	4	5	0	0	2	6	0
Doubtful	3	2	1	1*	1*	0	1	2	0
Papillary carcinoma	13	12	1	4†	4†	5	3	6	4‡
Infiltrating	11	10	1	0	2	2	5	1	6

* Duplicated.
† Twice duplicated.
‡ One by apoplexy; three by tumor.

As I have only been employing this treatment for three years, there are no late results to be reported as yet. These can only be inferred from the good results obtained by Barringer with glass seeds.

The suprapubic radium emanation implantation in metal seeds has not entirely eliminated the radium burn. Even as high as twenty seeds of 1.5 gold-screened emanation, or thirty seeds of 1 mc. have caused no inconvenience. But repeated implantation is always dangerous. Intense radium cystitis, lasting several months, has twice followed the second implantation, twice the third.

[4] *Tr. Internat. Urol. Ass.*, 1927.
[5] *J. Am. M. Ass.*, 1928, xc, 350. See also *T. Am. Ass. Genito-Urin. Surg.*, 1928.
[6] *J. Am. M. Ass.*, 1928, xc, 352.

These were all desperate infiltrating cases except one, which was a relapsing papillary carcinoma. One of them bids fair to survive.

I have had little experience with x-ray therapy. It seems singularly inefficacious. Suprapubic fulguration, except for multiple papillomata, seems less far-reaching in its effects than radium. Diathermy, if severe, intoxicates, if mild, does not control the more virulent lesions. Indirect radiation, such as Young uses, is incomparably inferior to implantation.

Treatment of Infiltrating Growths

Here there is room for difference of opinion as to whether the radium metal seed emanation implants are better than resection. They are more widely applicable, for any tumor may be treated by radium, while many of the infiltrating growths about the bladder neck do not admit of resection, and many others about the ureter mouth give a high operative mortality and a high percentage of recurrence if resected. But the primarily infiltrating tumors are almost all fatal, however treated. Barringer seems to have four of them in his list of five-year cures. I have one who looks promising.

For the treatment of these, the worst risks, one may properly consider complete cystectomy, if the tumor has not infiltrated too far. The operative mortality, double that of resection, which runs about 20 per cent, is all but prohibitive. I have twice performed the operation. One patient died of the operation, the other of recurrence.

OTHER TUMORS OF THE BLADDER

The occurrence in the bladder of tumors other than those of epithelial origin is so rare that no clinician has seen them often enough to form a clinical impression of their actual characteristics. Verhoogen [7] has given a modern summary.

Sarcoma.—The tumor occurs in extreme youth or in old age. It is sessile, usually single, its surface smooth or vegetating. It spreads rapidly and has resisted all surgery. It is possible that radiotherapy may help ameliorate the symptoms.

Retrovesical sarcoma is equally fatal.

Myxoma.—These "polyps" resemble nasal polyps. They occur in childhood, are usually pedunculated and tend to recur when removed unless the base is excised or cauterized. Fibromyxomata have also been described.

Leiomyoma (Fibromyoma, Angiomyoma).—This tumor is benign, grows slowly, pushing its way into the bladder cavity, sometimes with a pedicle, or bulging on the outer surface of the bladder. It may bleed and be mistaken for carcinoma. It may be enucleated. In view of its resemblance to uterine myomata it is singular that it has not been treated by x-ray.

[7] *Encycl. franç. d'urol.*, 1923, iv, 425.

Hemangioma.—The localized mass of dilated vessels ulcerates and bleeds freely and is therefore usually mistaken for carcinoma. It may be excised or shriveled by radium implantation or by the actual cautery.

TUMORS OF THE URETHRA

The granulomata of the urethra, mere exuberant granulations due to chronic urethritis, do not concern us here. Nor do the inflammatory cysts.

Among true neoplasms are included angioma, papilloma, adenoma, carcinoma, sarcoma.

Angioma.—The urethral caruncle or polyp, so common near the external urinary meatus of aged women, is perhaps a true tumor, perhaps a result of inflammation. It appears as a wee red, almost pedunculated, tumor at the urethral orifice. The tumor is exquisitely sensitive and sets up a bladder irritation resembling an intense acute cystitis. I have seen a woman almost demented by the pain.

When removed these little tumors often return. A convenient way to get rid of them is to implant a seed of radium emanation in the base under caudal anesthesia. They may also be removed by cauterization with the high-frequency spark.

Papilloma.—We must distinguish the papillomata that invade the posterior urethra by implantation of bladder papilloma from those that are primary in the fossa navicularis and to a less degree the rest of the urethra.

The papilloma derived from the bladder retains all the tendency to malignancy of its primary growth. But the urethral neoplasms bleed so freely both backward into the bladder, causing hematuria, and forward into the anterior urethra, causing urethrorrhagia, that they are discovered early. They are readily destroyed by fulguration under caudal anesthesia.

Primary papilloma of the urethra is usually seen in the terminal inch of the canal, but may extend down into the bulbous urethra. They are usually of quite insignificant malignancy, but are most difficult to get rid of. If few in number they are best treated by the high-frequency spark. If numerous, it is customary to attack them first by rubbing off the growths with the sharp edge of a urethroscope and fulgurating those that recur.

Adenoma.—Adenomata of the posterior urethra are a rare result of posterior urethritis. Player and Mathe [8] have described them.

They occur as masses of gland tissue that look like large granulomata. They cause a mild urethral discharge. They may be destroyed by fulguration through the urethroscope under caudal anesthesia. Several treatments may be necessary to eradicate them.

Sarcoma.—Mark [9] has collected the eight reported cases of sarcoma of the female urethra. One of them was a melanosarcoma.

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[8] *J. Urol.*, 1921, v, 177.
[9] *Ann. Surg.*, 1912, lv, 416.

Carcinoma.—Carcinoma occurs in the urethra either as a degeneration of papilloma or with a previous history of ancient stricture that suggests the scar as the origin of the neoplasm. I have seen several such in the bulb or adjacent portion of the canal. They are usually operated upon as strictures. Those I have seen were too extensive for excision. One would suppose them amenable to radiation, if diagnosed before operation. (*Cf.* Imbert.[10])

[10] *Encycl. franç. d'urol.*, 1921, v, 739.

CHAPTER XXXVIII

TUMORS OF THE PROSTATE

TUMORS of the prostate are almost always primary. Extension of a vesical cancer to the prostate is extremely rare, while extension of a prostatic growth to the bladder is not uncommon. Sarcoma occurs in youth, carcinoma in old age.

Sarcoma is extremely rare. Carcinoma of the prostate was found forty-three times in 38,472 autopsies (Kuemmell [1]); 21 per cent of all prostatic lesions. The Mayo Clinic reports 878 prostatectomies, of which ninety-three were for carcinoma, while eighty-four other cancers were not operated upon. Young [2] reported that among five hundred cases cancer was found once for every five cases of prostatism operated upon. Neuber [3] states that prostatic cancer forms from 1.42 to 2 per cent of all cancers.

Sarcoma.—Powers [4] collected thirty-one cases, of which fourteen were small round-celled or "mixed" growths. Of the thirty-one, fifteen occurred in children less than eight years of age, and three of these in infants less than a year old, eight between the ages of fifteen and twenty-five, and six between the ages of fifty and seventy.

"The diagnosis is at times easy, at times difficult. A rapidly growing tumor of the prostate in a child or youth is probably a sarcoma. So, as well, is a rapidly growing, soft, balloon-like prostatic tumor in an adult. Pain is generally marked, and is referred to the pubes, perineum and rectum. Urinary urgency is not generally present in the early stages. As in the case which forms the subject of this paper, an enormous growth may be unaccompanied by residual urine.

"Prognosis in these cases is necessarily bad. In each of the authentic cases submitted to analysis by the writer either (*a*) the disease went on to a fatal termination, or (*b*) the patient succumbed to operation or (*c*) to relapse after operation, or (*d*) the case was reported simply as an operative recovery" (Powers).

Carcinoma.—Carcinoma occurs almost exclusively after the age of fifty. Thus Judd classes his ninety-three operated cases by decades, from fifty to ninety years, as twenty-one, thirty-four, thirty-six, and two cases. He has seen a few cases before fifty.

Young distinguishes four types of prostatic adenocarcinoma:

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[1] *Surg., Gynec. & Obst.*, 1915, xx, 274.
[2] *Ann. Surg.*, 1909, l, 1232.
[3] *Ztschr. f. urol. Chir.*, 1910, ii, 405.
[4] *Ann. Surg.*, January, 1908.

Type 1 is an adenocarcinoma ("extra-acinous multiplication of small acini").

Type 2 is similar but the acini are elongated and branching.

Type 3 is an intra-acinous proliferation of tumor cells (the alveolar carcinoma of Geraghty).

Type 4 is the so-called medullary type, the cells growing so rapidly as not to differentiate into tubular masses.

No amount of epithelial proliferation and piling up within the acinus is evidence of carcinoma of the prostate; for these changes may be brilliantly illustrated in simple prostatism. It is only when the epithelia break through the stroma that carcinoma can be diagnosticated. The pictures are often so confusing that only the most convincing evidence should be accepted.

Small masses of carcinoma are found in the masses of hyperplastic tissue removed by prostatectomy from the lateral lobes in 10 per cent of cases (Albarran and Halle). Though characteristic of malignancy to the eye of the pathologist, the clinician regards them with calm, for after prostatectomy when such little tumors are removed, clinical carcinoma of the prostate rarely develops. This may perhaps be because at operation the whole tumor in the midst of the lobe is removed.

Young remarks that such carcinoma is rare in the enlarged middle lobe. Clinically this is so. The ulcers seen on that lobe, though they look like carcinoma, are caused by the trauma of catheterization and are entirely benign.

The growth of carcinoma within the prostate is slow and results in a considerable amount of fibrous change. This it is that we recognize clinically as the hardness of the carcinomatous prostate. Whether the growth actually begins in the posterior lobe, as Geraghty taught, or in the lateral lobe, is not absolutely clear, though the removal of small masses of tumor within the lateral lobes would make it seem probable that the actual origin of many tumors is in these lobes.

Be this as it may, by the time the tumor is clinically recognizable it has extended to the posterior lobe, thereby affording the clinical feature most depended upon to distinguish prostatic carcinoma during life.

The posterior lobe, which lies below the ejaculatory ducts and is never affected by prostatism, extends from one side of the prostate to the other. It is thickest at the apex, and thinnest at the base. It therefore lies between the examining finger and any other portion of the prostate, and if it is carcinomatous, it is impossible to distinguish by rectal touch whether the carcinoma is in the lateral lobe or elsewhere; one can only feel a hard nodule. The neoplasm extends in two directions—it first follows the ejaculatory ducts, breaking through the upper border of the prostate. Thence it slowly invades the trigone, but passes rapidly up between the bladder and the seminal vesicles, extending toward the lateral walls of the pelvis in the sheath of the vesicle so that the palpating finger from the rectum feels what seems to be a thickened and indurated vesicle, while at the same time the extension through the upper border of the prostate can be felt as a hard ridge along this organ.

In the second place, the carcinoma extends throughout the gland itself, perhaps invading and replacing the lesions of prostatism there. The fascia of Denonvillier effectively prevents the extension of the carcinoma to the rectum until very late in the disease. The growth reaches the surface of the urethra and the bladder somewhat more readily, but even this progress is slow compared to its extension within the pelvis. It is not uncommon for the carcinoma to cause retention of urine while no ulceration is present and no hematuria has occurred. If rectal stricture occurs, this is likely to be high up about the upper extremities of the seminal vesicles.

The pelvic and lumbar glands are involved early, so early indeed that the patient may die of glandular involvement or other metastasis before the carcinoma of the rectum has grown to sufficient size to be noteworthy.

Bone metastases occur in two-thirds of the cases that are not killed by operation. The bones most frequently invaded are the lower lumbar vertebræ and the sacrum.

The lymphatics carry the neoplasm to the lumbar and thoracic nodes and thence to the node above the clavicle on the left side where the thoracic duct empties into the subclavian vein.

Symptoms.—Cancer within the prostate gives either no symptoms at all, or only the vaguest and most unimportant perineal discomfort. In as much as the primary growth may remain small for many years, bone or glandular involvement may predominate early in the disease.

Thus bone involvement, secondary to carcinoma of the prostate, may be the one clinical evidence of the disease during life; this occurs in a large minority of cases.

Sciatica and pelvic pain, due to involvement of the sacral nerves in the metastases of the lumbar vertebræ or the pelvic lymph-nodes is often one of the earliest symptoms. It may precede the urinary symptoms by several years. Bilateral sciatica in an old man is all but pathognomonic of prostatic carcinoma.

Abdominal tumor, due to carcinoma of the lumbar glands, I have once seen as the predominating early symptom in a patient who died without ever having any symptoms directly referable to his prostate beyond a very slight perineal discomfort.

Retention of urine, showing itself by frequency of urination, or acute complete retention quite comparable to that of simple prostatism, is often the symptom of carcinoma of prostate. The retention of carcinoma usually begins a decade later than that of prostatism.

Hematuria is a less common symptom in carcinoma than in simple prostatism. It occurs late for reasons already stated. It was noted in 22 per cent of Judd's cases.

Rectal obstruction and ulceration and urethrorectal fistula are terminal complications, as are edema of the lower extremities and genitals and cachexia.

Adenocarcinoma of the trigone is usually a direct extension from the prostate. Ulceration on a large middle lobe is traumatic, not carcinomatous.

Prognosis.—The disease is usually fatal in two or three years. The most rapid case I ever saw died within one year of the time that my first examination had left me in doubt as to whether there was a small nodule of carcinoma in the prostate or not. On the other hand, one of my cases took twelve and another ten years to die from the time in which I diagnosed carcinoma. No attempt had been made to remove the growth. The average survival after diagnosis is less than two years.

Diagnosis.—Prostatic carcinoma should be suspected whenever an old man has a bone tumor, sciatica or pelvic pain or urinary disturbances characteristic of prostatism.

The frequent association of prostatism with carcinoma obscures the diagnosis unless this is undertaken methodically.

Rectal touch will usually disclose the presence of carcinoma of the prostate. Within the gland the neoplasm shows itself as one or more hard nodules, one of these being usually at the apex of the prostate. Such nodules are not pathognomonic; they may be due to tuberculosis, stone or ancient prostatitis. Unless other evidences of carcinoma are present outside the prostate, a diagnosis should never be concluded without an x-ray examination for prostatic stone, and an examination by rectal touch with a sound in the urethra. The presence of the sound brings out the great hardness as well as the usual position of the carcinomatous infiltration in the mid-line of the prostate between the sound and the urethra. Stone occurs only in the lateral lobes.

On the other hand, the most convincing evidences of carcinoma are those that appear above and beyond the prostate. The hard ridge just above its upper edge, extending outward and sheathing one or both of the seminal vesicles in a solid mass is the pathognomonic local sign.

Cystoscopy may be quite negative if there is no retention of urine. When there is retention the cystoscope discloses one or more of the following conditions:

1. The prostatic urethra is deflected or obstructed by the tumor. Perhaps the instrument cannot be made to enter the prostatic urethra at all. Or it cannot be made to pass the bladder neck. Or it is deflected laterally or upward. Under such conditions the urethroscope may reveal irregular carcinomatous nodules within the canal.

2. The bladder neck is tight, the instrument lies with its beak elevated. The bladder neck is at least irregularly edematous. Irregular carcinomatous nodules or ulcers may project from it.

3. The trigone is elevated by the underlying growth, perhaps edematous, perhaps nodular or ulcerated. Or the most notable change may be a papillary carcinoma of the trigone that suggests carcinoma of the prostate only by its situation.

Radiography of the bones reveals metastases in the lumbar vertebræ, through the pelvic bones or elsewhere.

Carcinoma of the node above the left clavicle may be the first sign of the disease.

Differential Diagnosis.—The diagnosis is difficult in two classes of cases:

The Tumor Is Overlooked.—This happens when the prostate is not thought of as a possible primary source of bone or abdominal carcinoma or as a cause of sciatica or retention of urine or when a careless examination of a prostate, actually containing carcinoma, fails to identify this.

There Is a Mass in the Prostate.—Distinct thickening of the apex of the prostate is apparently never due to anything excepting tuberculosis in youth, and carcinoma in age. Indurations elsewhere over the lateral lobes may be identified as carcinoma by their great hardness and a negative x-ray, by the associated extraprostatic lesions, or by infiltrations seen by cystoscopy.

Treatment.—No satisfactory *radical treatment* has yet been devised for carcinoma of the prostate. Young has been for many years the chief advocate of radical operation for removal of the prostate with its contained carcinoma and claims a dozen radical cures. I have seen one such radical cure persisting four years. Twenty of Young's patients were operated upon three years preceding the last examination. Fourteen were alive and apparently free from recurrence. After five years eight out of thirteen were alive and apparently well. Of this grand total of twenty-four cases, none had any obstruction to urination, ten had perfect control of urination, three total incontinence of urine, seven partial incontinence.

This radical operation is of course only applicable to early cases with tumor confined to the gland. I have preferred to operate upon such cases as were free from retention by exposing the posterior surface of the gland and implanting metal seeds of radium emanation at each corner of each c.c. of tumor. This operation is an unimportant one if the rectum is respected. It does not threaten the function of urination. One of my cases is apparently well three years after implantation.

If there is retention I prefer to open the bladder, cut away with rongeur forceps all palpable tumor masses and implant radium seeds in the wound. This relieves the retention but usually fails to cure the carcinoma.

Barringer prefers to plunge into the carcinomatous prostate two steel needles containing 25 mm. of radium element to remain in place one hundred hours, or a corresponding amount of emanation. He has obtained 4 per cent cures by this method. He attacks retention by the Young punch.

Young has applied radium indirectly to the prostate through capsules introduced into the urethra and the rectum. If enough is used to control the growth, severe reactions are likely to result.

The palliative treatment of incurable prostatic carcinoma consists of two parts: viz., control of the progress of the local disease and treatment of distressing symptoms. In the effort to check the local progress of the disease massive deep x-ray therapy should be tried. This may greatly relieve retention, local

pain, and pain or edema of the lower extremities due to the pressure of the tumor upon the pelvic veins or nerves.

Of the remaining symptoms the following may be said:

Retention of urine may be attacked with modest prospects of success by many methods. Even in preradium days suprapubic prostatectomy, as for adenoma, occasionally relieved retention for a number of years, and Young contends that this is one of many virtues peculiarly attributable to his perineal procedure. Barringer states that after his radium needling, retention rarely recedes, never increases. When retention is actually present he needles with radium and uses the Young punch. All else failing, permanent suprapubic drainage may be established. Even the catheter sometimes helps, though it may be prohibited by the carcinoma blocking the urethra, and often rather irritates than relieves the patient.

Metastasis and pains in the legs, due to metastasis in the lumbar spine, are beyond treatment unless by deep massive x-ray. One employs morphin liberally.

CHAPTER XXXIX

MALFORMATIONS OF THE KIDNEY AND URETER

The malformations of the kidney and the ureter are explicable in terms of the embryological development and migrations of these organs.

"The kidney-secreting substance extends as mesothelial bodies or nephrogenic tissue from the lower dorsal to the second sacral vertebra. They lie close together with the aorta between. This substance is supplied by many blood-vessels derived from a delicate plexus surrounding and connecting with the aorta. From a pouch which early appears from the lower portion of the wolffian duct are developed the ureter and pelvis of the kidney. This collecting portion becomes attached to the secreting portion by climbing up the ladder of the blood supply, so to speak, of the nephrogenic substance. The numerous blood vessels drop off or enlarge as the pelvis of the kidney ascends to its higher position, and the secreting substance arranges itself over it and forms a capsule. The two mesothelial bodies may touch each other and become fused, developing the horseshoe kidney or various attachments; 90 per cent of the horseshoe kidneys being fused at the lower pole. Some of the mesothelial or secreting portion of the kidney may not become connected with the collecting portion and may then retain its embryonic type, forming a mesothelial rest from which may develop so-called 'hypernephroma' or, more correctly, mesothelioma of the kidney (Wilson). In other cases a failure of connection between the secreting portion with the collecting cavity and continuance of secretion without elimination form a congenital cystic kidney, usually double.

"Wherever the kidney stops in the process of union of collecting and secreting portions, its renal artery develops from the major one supplying it at the time. As growth continues, the delicate vascular plexus outside the aorta disappears and the renal artery comes directly from the aorta; but owing to change in position it may come from a lower position on the aorta, the sacral artery or from the common iliac. The malposition of the kidney is not so serious if it can but carry on its function, but malposition may lead to injury. Excessive mobility is not a disease unless the renal function is interfered with or the kidney in its movements disturbs some other organ; thus the movable right kidney may disturb a diseased appendix, the appendix, however, being the primary offender. Mobility may interfere with urinary delivery by kinking the ureter over a band of connective tissue or an anomalous artery which occasionally is seen connecting the lower pole of the kidney with the aorta, one of the original mesothelial vessels which failed to disappear. One kidney may be missing from a failure of development of the mesothelium—the secreting structure. Three or four

kidneys may be present with three or four complete ureters or partial ureters. Splitting the collecting portion at the wolffian duct causes double ureters and fused or separated double kidneys on one or both sides. The division of the pelvis into several tubes connecting with one or two ureters is normal in the otter and beaver." (C. Mayo.)

MALFORMATION OF THE KIDNEY

Frequency.—Abnormalities of the kidney are very rare. Morris collected the records of 11,168 postmortem examinations at the Middlesex Hospital and Guy's. Excluding movable kidneys, sixteen cases of double ureter, and fifty-three cases of acquired atrophy and small cirrhotic kidney, his cases may be tabulated thus:

Congenital atrophy (aplasia)	11 cases
Fused kidney	1 case
Horseshoe kidney	16 cases
Lobulated kidney (4 bilateral)	9 cases
Malformed kidney (1 bilateral)	6 cases
Misplaced kidney	10 cases

About one case in 211.

Motzfeldt [1] found seventy-nine cases of deformity of some kind at 4,500 necropsies, including nine of horseshoe kidney; double ureters in twenty-three; hydronephrosis in twenty-one; aplasia in ten, and hypoplasia in eleven—a total of deformities of some kind in the urinary apparatus in 2 per cent of all the cadavers. One of the kidneys was abnormally small in twenty-two cases; the other was hypertrophied in a few instances.

Congenital Malformations

Absence of Kidney.—Both kidneys may be absent at birth.

Absence of one kidney occurs, according to Ballowitz, once in 2,400 autopsies. In 90 per cent the ureter is absent as well; in 10 per cent rudimentary.

Supernumerary Kidney.—The supernumerary kidney may be separate or fused to the kidney on the same side. It has a separate ureter. The supernumerary organ lies below the normal one. Kretschmer has collected the reported cases.[2]

Malformation without Fusion.—Most of the malformations without fusion are unimportant. *Fetal lobulation* may persist in part or in the whole of a kidney throughout life. *Simple hypertrophy* of a kidney is usually compensatory to insufficiency of its fellow. Neither of these present any surgical interest excepting that the latter may be mistaken for tumor. The *misplaced kidney* is usually

[1] *Norsk Mag. f. Lægevidensk.*, 1914, lxxv, No. 7.
[2] *J. Am. M. Ass.*, 1915, lxv, 1447.

rotated on both its axes and may be deformed by the pressure of the surrounding viscera. Movable kidneys may assume very curious shapes. Considerable malformation of the kidney is usually associated with misplacement and is of interest in that connection.

Aplasia.—Extreme atrophy of the kidney of congenital origin is extremely rare. Geraghty and Plaggemeyer [3] find that the estimates vary from 1 in 110 to 1 in 3,993 cases. The disagreement is due to the variation in what the observer is willing to accept as an aplastic kidney. Partial congenital atrophy or smallness of a kidney is not infrequent. I encountered it three times in operating upon 186 kidneys. The condition is of the utmost surgical importance because the small kidney may be entirely normal and yet not possess sufficient kidney tissue to support life, while its fellow may be diseased and require nephrectomy. Unless care is taken in the ureter catheter diagnosis the fact that the healthy kidney is putting out but a small quantity of urine may be overlooked. Geraghty called attention to this fact and gave a formula for the recognition of the condition, which, of course, applies to acquired as well as congenital atrophy. The formula, as applied to the healthy kidney, is the following:

The amount of urine excreted is small. Therefore, though the percentage of urea is normal, the total urea is diminished. The phenolsulphonephthalein output is also diminished. By the use of this formula, I was able to diagnose atrophy in the kidney shown in Plate XII. The x-ray had previously shown the stone; the cystoscope revealed a very small middle lobe of the prostate; ureter catheters were readily introduced on both sides, and there was no extracatheter flow. The urine from the right kidney showed a few pus cells, 1.2 per cent urea, 7 per cent phenolsulphonephthalein in 2 c.c., after a delay of ten minutes in its appearance. The left kidney gave no pus, urea 1.3 per cent, 25 per cent phenolsulphonephthalein in 8 c.c.

Anomalies of the Blood-Vessels.—Rupert [4] in a review of this subject, chiefly founded on a personal study of 118 cadavers, found among the 236 kidneys examined 77 arterial and 26 venous abnormalities. Fortunately, however, the surgeon does not require to make an intimate study of these variations, but simply must know that they are extremely common. In the normal kidney the main artery and vein may be double, and may not arise directly from the trunk vessels. Moreover, accessory arteries and veins may run to the upper or lower poles. The careful surgeon will, therefore, always palpate any bundle of rather thick tissue or adhesion at either pole of the kidney before cutting this. If the pulsation of an artery is felt in it this will be spared if possible, for the renal arteries are, to all intents and purposes, terminal. If no pulsation is felt the band of tissue will be separated gently, and if a vein is found or accidentally torn this will simply be ligated, for venous anastomoses within the kidney are plentiful.

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[3] *Tr. Am. Ass. Genito-Urin. Surg.*, 1913, viii, 48.
[4] *Surg., Gynec. & Obst.*, 1915, xxi, 471.

The misplaced or malformed kidney usually has a number of irregular arteries and veins arising from adjacent portions of the great vessels.

The Misplaced Kidney.—The misplaced, dystopic or pelvic kidney is totally different from the movable kidney. The latter has reached its normal position at the loin, but has a long pedicle and a certain degree of mobility within the loin. The misplaced kidney has never reached its normal position, and is fixed in an abnormal one (Fig. 117).

The following data are derived chiefly from the contribution of Plummer:[5]

Whereas the movable kidney is usually on the right side, the misplaced kidney is usually on the left side. The misplaced kidney may be found either in the bony pelvis or in the region of the promontory of the sacrum. The majority of misplaced kidneys are not single kidneys but the majority of single or fused kidneys are misplaced. Of Strater's cases, twelve were hydronephrotic, six pyonephrotic. He also noted stone, sarcoma, tuberculosis and cystic disease.

FIG. 117.—MISPLACED KIDNEY.

The kidney is not greatly misshapen. But it is infected—whence the clubbing of the calices—and rotated. On the opposite side the lower pole of the left kidney is seen and lower down a few irregular shadows, probably calcareous glands.

Many misplaced kidneys function perfectly well during life, and are found at autopsy. They may themselves become diseased, in which case they give the symptoms of the disease with which they are afflicted, but the most frequent way in which they arouse surgical interest is by their interference with pregnancy. The pregnant uterus, pressing upon the misplaced kidney, is very likely to cause acute retention or infection, or, on the other hand, if the kidney is sufficiently diseased to become a large mass, it may actually impede the progress of pregnancy. A feeling of weight and pain in the lower abdomen may result from the misplaced kidney. Misplacement of the kidney will be suspected whenever pregnancy is interfered with by an obscure abdominal growth, or when the symptoms of some renal disease are associated with a mass in the lower portion of the belly. The condition can be satisfactorily diagnosed only by urography. D. Bissell[6] has been able by careful dissection in three cases to replace the misplaced kidney sufficiently high in the loin to insure the three essentials; freedom

[5] *Surg., Gynec. & Obst.*, 1913, xvi, 1.
[6] *Tr. Am. Gynec. Soc.*, 1911.

from pressure, good ureteral drainage, and good vascular supply. Strater suggests that this is the proper treatment at the beginning of pregnancy, but that in the last few months premature labor should be induced, and nephrectomy or replacement performed later. Cesarean section may be necessary. Cragin made a vaginal puncture of a hydronephrotic pelvic kidney. Fifteen hours later the patient went through a normal labor.

The Fused and Horseshoe Kidney.—The single kidney results from atrophy of, or absence of, its fellow whose ureter is either entirely absent or only partially developed. Fusion of the kidney results from actual union of the two kidneys with two or more ureters draining the combined mass. The commonest form of fusion is the *horseshoe kidney*. The two kidneys lie usually a little lower than their normal position with their lower poles bound together either by a band of fibrous tissue, or by an isthmus of actual renal tissue. This isthmus in 9 cases out of 10 lies in front of the great vessels. *The ureters usually pass in front of the isthmus.* Fusion of the upper pole is extremely rare. Thirty cases were found in 21,218 autopsies, or one in 707, collected by Morris, Preinelsverger and Socin. Rovsing[7] records as extreme statistics the reports of Kraft and Scheel, who found twelve cases in 9,142 autopsies, or one in 500, and Fibiger, who found but one horseshoe kidney among 2,294 autopsies. I have encountered the condition four times in some 250 operations for renal disease.

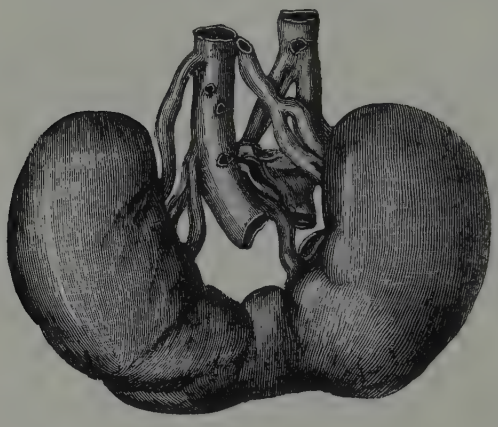

Fig. 118.—Horseshoe Kidney.

The "S" or *sigmoid kidney* is a form of renal fusion in which one kidney lies below the other, each organ being somewhat misshapen; and the upper pole of one being fused to the lower pole of the other. The remaining rare conditions may be classified as the "misshapen kidney." Such kidneys are often misplaced, and usually in the middle line near the promontory of the sacrum.

Rovsing deduced the clinical picture of horseshoe kidney consisting of a pain across the abdomen induced by exertion, exaggerated when the patient bends over backward, and relieved by lying down. A tumor can sometimes be palpated in front of the great vessels.

The diagnosis of horseshoe kidney is made by urography. The two kidneys are low but instead of being rather far out laterally, as low kidneys usually are placed, the low horseshoe or fused kidney hugs the vertebral column and its calices on one side sweep downward and across the line of the ureter (Fig. 118).

[7] *Hospitals Tidende*, 1910, liii, 1481.

The condition is diagnosed during operation by finding the ureter in front of the lower pole of the kidney, and later identifying the connecting band. Division of the band uniting the two kidneys retroperitoneally is not a difficult operation. Nephrectomy is easy because the kidneys are so low. But the immobility of the kidney adds greatly to the difficulty of pyelolithotomy.

FIG. 119.—PYELOGRAM OF HORSESHOE KIDNEY.

The kidney pelvis is displaced toward the mid-line. The ureter crosses the lower calices which are greatly elongated and turn inward. This patient was progressively more and more debilitated by the restricting effect of the isthmus. As soon as it was divided she was, and has remained, completely relieved of what was becoming a chronic invalidism.

ABNORMALITIES OF THE URETER

Absence of Ureter.—Absence of the ureter, implies the absence of the corresponding kidney. Absence of kidney does not, however, necessarily imply absence of the corresponding ureter. A portion of this may persist, and may even be patent, though it is likely to be so narrow as not to admit a ureter catheter.

Reduplication of Ureter.—Total reduplication is said by Wedensky [8] to occur in at least 1 per cent of autopsies, usually on the left side. The double ureter is often not associated with any notable malformation of the kidney, but a number of cases have been reported with infection or stone in one of the pelves, and not in the other (*cf.* Mertz).[9] The condition has also led to confusion in diagnosis, since on one catheterization the urine appears normal, and on a subsequent one, perhaps by a different observer, the urine from the same kidney is found purulent. Indeed the condition has led to a false diagnosis of the spontaneous cure of renal tuberculosis.

The ureter from the lower kidney pole takes the normal course, and enters the trigone at its usual angle. The ureter from the upper pole is longer at both ends, it debouches at some point below the angle of the trigone.

The diagnosis of ureteral reduplication is often made by cystoscopy. One should form the habit of always inspecting the trigone immediately below the normal ureter orifice on each side in order not to overlook this abnormality. A patient in Bellevue Hospital with renal colic was cystoscoped by one of the assistant urologists without finding any abnormality. I took over the instrument and saw a phosphatic calculus protruding from the side of the trigone halfway between the ureteral and the urethral orifices. A touch with the catheter released the stone.

Urography suggests the presence of reduplication of the pelvis and ureter when the pelvis itself is small and opens into small stunted calices, especially if

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[8] *Folia Urology,* Oct., 1911, p. 345.

[9] *Urol. & Cutan. Rev.,* 1920, xxiv, 626; also Braasch and Scholl, *J. Urol.,* 1922, vii, 507.

the pelvic shadow does lie in the center of the shadow of the kidney. The upper pelvis is the one usually stunted (Plate V, Figs. 7, 8, 9).

The illustrations exemplify the usual forms of reduplication and accompanying rotation.

Incomplete Reduplication.—The calices may fail to unite within the hilum, thus producing the so-called extrarenal pelvis, though usually in such cases there is no pelvis at all at the junction of the calices (Plate V, Figs. 4, 5).

It is usually the two major calices that fail to unite, though three or four calices may issue separately from the hilum (Plate V, Fig. 6).

Such abnormalities are not extremely uncommon. But the two major calices may fail to unite until they reach the brim of the pelvis. This condition is sometimes recognized by urography, the fluid filling the two branches of the Y.

Abnormalities in the Course of the Ureter.—In the embryo the ureter is surrounded by a plexus of branches of the cardinal vein. Normally the original lateral channel of this vein disappears and the mesial portion develops into the inferior cava. But if the lateral instead of the mesial portion persists, the cava winds around the ureter, which then lies in the lower part of its abdominal course mesial to the cava, which compresses it and may cause hydronephrosis. This anomaly, common in the cat, is rare in man. Graves and Davidoff [10] have collected three such cases.

The ureter running to a unilateral fused kidney, though terminating normally, crosses the bony pelvis to reach the fused kidney on the opposite side of the body.

Abnormalities of Implantation.—Abnormal implantation of the ureter into the renal pelvis results in hydronephrosis (*q.v.*). Abnormal implantation of the lower end of the ureter is usually associated with reduplication of the ureter. It is the longer ureter, the one from the upper pelvis, that is implanted abnormally. The common abnormal point of implantation is, as stated above, a point on the trigone between the implantation of the short ureter and the urethra on the edge of the trigone. Exceptionally this abnormal implantation may be even lower, in the urethra, or in the vestibule of the female, close to the meatus. Or, by failure of the normal shifting of the ureter, in the seminal vesicle, the vas or the ejaculatory duct. Or, by abnormal shifting, in the vagina or uterus. Or, if the urethrorectal septum fails to develop, in the cloaca.

Kelly cured a patient of the dribbling resulting from urethral implantation by inserting a catheter into the abnormal ureter and, pressing this forward into the bladder by a finger in the vagina, opening this duct widely into the bladder.

Most of the implantations of the ureter outside the bladder either occur in monsters or result in destruction of the kidney, so that they require no operation or are relieved by nephrectomy. Exceptionally, it may seem wise to reimplant the lower end of the ureter into the bladder.

Megalo-Ureter.—This term is usually applied to the enormous ureteral dila-

[10] *J. Urol.*, 1922, viii, 75.

tation that results from stricture, usually congenital. But megalo-ureter is said to occur as a congenital anomaly in children who show no obstruction to the outflow of urine either in the ureter or in the urethra, in the form of congenital sclerosis at the bladder neck. Cystoscopy reveals the wide open ureter mouths, the condition being usually bilateral, and cystography results in reflux of the medium up the dilated ureters. Such patients usually die young but may reach adult life. The only relief possible is by ureteral implantation into the skin or the bowel.

Stricture of the Ureter.—Congenital stricture has been studied by Bottomely.[11] Strictures, valves and partial atresia have been noted in various portions of the ureter. They are commonest at the bladder orifice where they lead to the introvesical ureteral cyst (see below) and at a point at, or near, the entrance of the ureter into the bladder wall. With congenital stricture is usually associated a congenital dilatation of the ureter and kidney pelvis above. The stricture may be so slight that it causes no symptoms until adult life is reached, but the usual result is congenital hydronephrosis and "megalo-ureter."

Intravesical Ureteral Cyst.—Stricture of the ureter, at its point of entrance into the bladder cavity, is not so very uncommon. The orifice may be reduced to so small a size that it would scarcely, or not at all, admit a ureter catheter. As a result the ureter above dilates, and especially that portion of it which lies underneath the mucous membrane of the bladder. This dilatation produces the so-called intravesical ureteral cyst. It may reach an enormous size, and may even be protruded from the urethra in the female. The smaller cysts are quite common and are associated with hydronephrosis (Plate I, Fig. 14).

Very large cysts may have to be incised through a suprapubic wound. The cysts I have encountered could readily be opened by fulguration of the roof of the cyst, which promptly falls off, leaving an open ureter mouth and relieving the hydronephrosis. The cystoscopic scissors should not be employed, as the cut may bleed so freely as to require suprapubic drainage to empty the bladder of clots.

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[11] *Ann. Surg.*, 1910, lii, 597.

CHAPTER XL

MALFORMATIONS OF THE BLADDER AND URETHRA

MALFORMATIONS OF THE BLADDER

Exstrophy

Exstrophy or extroversion of the bladder, in case of ectopia vesicæ, is more common in the male than in the female. Neudoerfer estimates one case to fifty thousand births and eight boys to one girl. Smeed reports three cases to twenty-eight thousand births (Edmunds [1]). In the female it does not prevent copulation. Cases of pregnancy and successful delivery at term are recorded. Half of all persons afflicted with exstrophy are dead by their tenth year; two-thirds by their twentieth year (Mayo and Hendricks [2]). Vulliet [3] states that 41 per cent of the little sufferers die within five years; 18 per cent in the next five years, and almost all the survivors perish before the age of fifteen. Death is usually due to renal infection.

The deformity is an arrest of union in the median line analogous to harelip, and is found in different degrees. In a typical case the lower abdominal wall and the front wall of the bladder are absent. The pubic bones are separated, their ends being united by a strong band of fibrous tissue. The posterior wall of the bladder, pressed out by the intestines, forms a mottled, red, tomatolike tumor, occupying the position of the symphysis pubis. Inguinal hernia of one or both sides is commonly present. The scrotum is usually normal, containing the testicles. The penis is rudimentary, and affected by complete epispadias. The ureters are sometimes greatly dilated. The pathology and etiology are given in detail by Connell [4] and Hovelacque.[5]

In exstrophy of the bladder the patient's condition is miserable indeed. The mucous membrane covering the protruded posterior wall of the everted bladder is inflamed, thickened, ulcerated, and covered by decomposing stringy mucus, the whole bathed in ammoniacal urine. It ultimately undergoes malignant degeneration.

The integument of the abdomen and thighs becomes excoriated and inflamed. The friction of garments in walking only serves to aggravate the existing difficulties, and the sufferer is in a truly pitiable condition.

During youth treatment consists in wearing a metal cup over the exstrophic

[1] *Practitioner*, 1914, xcii, 501.
[2] *Surg., Gynec. & Obst.*, 1926, xliii, 129.
[3] *Lyon chirurg.*, 1913, ix, 589.
[4] *Am. M. Ass.*, 1901, xxxvi, 637.
[5] *J. d'Urol.*, 1912, i, No. 2.

bladder with a tube from it leading to a rubber urinal. This must be worn until the child is six or eight years old. Then operation may be contemplated.

No operation for closure of the bladder has ever succeeded in restoring control of urination. The bladder must be obliterated, the ureters transplanted into the bowel. In describing the operation we give the preference to extraperitoneal implantation in spite of the fact that we have done a number of Coffee operations, but none for exstrophy, and that Charles Mayo and Hendrick [6] have reported excellent results from the Coffee procedure. They state that in the preceding twenty-five years, sixty-six cases have been operated upon and, in sixteen years, twenty-nine patients refused operation because they were too young, because the rectal sphincters were relaxed, because there was malignant growth of the bladder, or because they were operated upon for conditions other than exstrophy.

Of the sixty-six operated upon, forty-six were bilateral ureter transplantations, nine unilateral. The bilateral operations were almost all done in two stages, ten days apart. Among the sixty-six operated upon, eleven died in hospital, five of peritonitis, six of renal infection or dilatation and insufficiency. Seven patients died after leaving hospital. Forty-eight survived. Twenty-nine reported as to condition. Twenty-five were satisfied. Seven had been recently operated upon, three reported a survival of one to three years, ten, three to six years, ten, six to twelve years, three, twelve to fifteen years.

No such large statistics support the claims of any other operation. But the same result is attained by the Peters' operation without opening the peritoneum. Individual cases have survived this procedure many years.

Diverticulum

A diverticulum of the bladder is a pouch of mucous membrane which has pushed through the wall of the bladder sufficiently to make a projection beyond this. Small pouches of the mucosa that do not deform the general shape of the organ are spoken of as saccules.

Diverticula vary in volume from a pouch only large enough to admit the tip of the little finger to pouches the size of which may exceed that of the bladder itself. Indeed though the original pouch apparently never contains a ureter, it often begins near the ureteral orifice and as it grows, draws the ureter into its cavity. Postmortem observations of such conditions by the earlier anatomists led to the phrase double bladder, but a double bladder, even though each half has a ureter emptying into it, probably began originally as a diverticulum. It is still maintained by some authorities that these large diverticula are congenital defects, independent of back pressure. But the weight of authority is in favor of considering them "blow-outs" of the bladder mucosa due in the major part to back pressure with perhaps some special predisposition in the weak musculature of the individual.

[6] *Surg., Gynec. & Obst.*, 1926, xliii, 129.

The diverticulum never arises from the trigone, though this may be drawn into it secondarily. It usually begins in the region of what might be called the lateroposterior fold of the bladder, the angle made by the descent of the vault of the bladder (as it empties) at a point some 2 or 3 cm. behind and external to each ureter. About half of the cases are bilateral.

The walls of the diverticulum are the normal muscular coats of the bladder but much thinned out and sclerosed.

As the diverticulum grows, it presses upon and kinks the ureter, thus causing hydronephrosis. Infection occurs and the diverticulum becomes densely adherent to all the surrounding structures, while the kidney becomes infected as well, perhaps pyonephrotic.

Secondary stone may be found in a diverticulum and papillary carcinoma in it has been noted a number of times.

Etiology.—Sclerosis of the bladder neck or some urethral obstruction should be looked for as the occasion of every diverticulum. Since adopting this rule, I have never failed to find some such obstruction.

Symptoms.—The uninflamed diverticulum is practically symptomless. Therefore a patient may reach a considerable age before the lesion gives any symptoms, though if the patient be intelligent, and the diverticulum large, close questioning will usually reveal the fact that there has been some unusual quality in urination, either an ability to hold an unusually large quantity of urine, or a difficulty of urination, extending back for many years.

The onset of symptoms, usually the age at which infection began, is shown in the following table made up of the cases collected by Fischer, Cabot and Lower:[7]

Below 20 years of age	3 cases
20 to 30	6 cases
30 to 40	10 cases
40 to 50	11 cases
50 to 60	8 cases
60 to 70	8 cases
70 to 80	3 cases

The clinical picture is a combination of infection and retention. Among the younger patients, as a rule, the history is that a chronic gonorrhea does not get well, or that they have difficulty in emptying the bladder. The catheter reveals a certain amount of residual urine. The older the patient, the more the symptoms of retention predominate, and hematuria may be added if there is stone or tumor. If the disease begins early in life the symptoms may be mild for many years. In several of my patients the symptoms lasted for more than ten years before cystoscopy revealed the true condition.

Diagnosis.—One may suspect the presence of a diverticulum whenever there is a prolonged chronic infection of the urethra or bladder with even a

[7] *J. Am. M. Ass.*, 1914, lxiii, 2015.

small amount of residual urine, or whenever there is residual urine otherwise unaccounted for. The diagnosis is made by cystoscopy which reveals the orifice of the diverticulum. A ureter catheter passed into the diverticulum shows whether this is large enough to be worthy of operation or not. It has been found clinically that any diverticulum large enough to permit a catheter to be coiled up in it requires excision if it has once become infected. Before operating, the diagnosis is still further confirmed by cystography. Since the pouches usually protrude to either side of and behind the bladder, radiograms are taken at a stereoscopic angle (Figs. 47, 48).

Treatment.—The mere fact of finding diverticula in the bladder does not indicate that these require treatment. The many small saccules that are often seen in bladders subject to prostatic retention of long duration give no trouble after prostatectomy. Only those diverticula require treatment that retain urine after the prostatic obstacle has been removed. If the diverticula are small and few and the prostatic obstacle seemingly very great, it is wise to operate upon the diverticula at the same moment as the prostate if the patient's condition permits, otherwise all doubtful cases are to be submitted to prostatectomy or excision of the sclerotic bladder neck first and to the attack upon the diverticulum only if the prostatic operation fails to relieve retention.

Occasionally the diverticulum is found very foully infected. This suggests the presence of stone or tumor. If cystogram reveals neither of these and the patient will permit cystoscopy, an attempt may profitably be made to clear up the infection before operation by leaving a visible ureter catheter tied into the urethra and running well into the diverticulum through which its cavity may be flushed out twice a day until the filthy infection has been controlled. Failing this, one may do the operation in two stages, first making a suprapubic cystotomy for drainage by tube of the various gravely infected diverticula and later excising these.

The published mortality of diverticulectomy is low; the actual mortality quite high. The operation requires much more surgical skill than does any other operation upon the bladder excepting resection for tumor. It is to be remembered that operation upon the sclerotic bladder neck is part of every operation for diverticulum.

MALFORMATIONS OF THE URETHRA

Among curiosities of deformity may be mentioned abnormal position of the meatus on the side of the glans penis; termination of the ejaculatory ducts in a separate canal running along the penis and opening behind the glans (gonorrhea of this canal has been noted); and termination of the urethra in the groin. Le Fort [8] has collected and classified the different varieties of fistula of the

[8] *Guyon's Annales*, 1896, xiv, 624, 792, 912 and 1095. See also MacKenzie, *Surg., Gynec. & Obstet.*, 1916, xxii, 344.

penis and the so-called double urethra, and shows that the second urethra is usually a blind pouch, a prolongation of the lacuna magna. Double normal urethra does not exist, except with double penis. Young (Footnote: "Urology") cites six cases of double urethra without reduplication of penis. He also discusses the reported cases of abnormal canals lying dorsal or central to the urethra.

Atresia

The obstruction is usually a thin membrane in the balanitic urethra associated with an open urachus. Puncture of the membrane is said to be followed by closure of the urachus. The atresia may, however, extend throughout the greater part of the urethra. Extensive plastic operations should be delayed until about the eighth year.

Valve in the Prostatic Urethra

Congenital infolding of the mucosa of the prostatic urethra, in the region of the verumontanum, is a rare cause of complete or incomplete retention of urine in the newborn or in childhood. An open urachus or a full bladder, palpable suprapubically, suggests the retention. The retention may take years to develop to a point where it is complained of. Thus, in a personal case, complete retention began at the age of eight and the condition was still not diagnosed until the age of eighteen.

In as much as these valves usually offer no resistance to instruments entering the urethra and are invisible by cystoscopy, the diagnosis can be made only by inference in the infant, by urethroscopy in the adolescent. The valves may readily be torn through a suprapubic incision, or fulgurated through the urethroscope. Young has cut them away with his punch, children's size.

Congenital Stricture

Congenital strictures, or even total occlusions of the urethra, usually occur at five places, though they may occur anywhere in the canal:

1. At the meatus
2. At the outer limit of the fossa navicularis (internal meatus)
3. At the membranous urethra
4. In the prostatic urethra (valve)
5. At the bladder neck.

Congenital stricture at the meatus, or at the inner end of the fossa navicularis, aptly termed the second meatus, is very common. Indeed, the size of the meatus is no more fixed than the size of the mouth or the nose, though, in

general, a small penis is more likely to have a contracted meatus than is a large one.

How much contraction constitutes stricture of the meatus? A meatus is strictured if a probe, introduced into the fossa navicularis and rotated so as to sweep the point outward along the floor of the urethra, encounters a thin membrane which it must surmount in coming out through the meatus. This obstruction always occurs on the floor of the canal, and is never anything more than a fold of mucous membrane that may be pushed out by the probe (Fig. 55). The second meatus is strictured if it is not so large as the normal true meatus.

Strictly speaking, the above rule holds good. Practically, however, stricture of the meatus—to which so many reflex ills were once attributed—rarely produces any symptoms. If actually so small as to interfere with urination it may, perhaps, like a tight prepuce, cause hernia in a child, and spasmodic stricture in later life, and the urethra may become considerably dilated behind it. But such cases are exceptional. Most men can go through life in blissful ignorance of the size of their meati unless they acquire a urethritis, in which event the stricture should be cut lest the little pocket behind it perpetuate the inflammation.

The only way to cure a stricture of the meatus is to cut it. As above remarked, this is, as a rule, quite unnecessary, except for the surgeon's purposes.

Congenital stricture in the membranous urethra is extremely rare. When found in the adult it is mistaken for acquired stricture and treated as such.

Congenital stricture at the bladder neck is usually promptly fatal and discovered postmortem. If the patient survives, the symptoms and course are those of prostatic sclerosis.

Urethral Cyst or Diverticulum

Diverticula are either congenital or acquired. Watts [9] collected sixteen congenital cases, twelve of them affecting the pendulous urethra. Johnson [10] reports on cysts of the urethra, notably those of Cowper's gland.

Prolapse of Urethra in Little Girls

Brüning [11] reports a case of the sudden prolapse of the entire mucous lining of the urethra, without apparent cause, in a healthy girl of 8. Study of the literature on this subject shows that this occurrence is observed in girls only in early infancy and between the ages of 8 and 12. Hemorrhage accompanied the prolapse in 41 per cent of the seventy-six cases he has found and tabulated. In a large proportion of the cases the prolapse was not recognized and dire results followed the treatment based on a mistaken diagnosis. The

[9] *Johns Hopkins Hosp. Rep.*, 1906, xiii, 49.
[10] *J. of Urol.*, 1923, x, 295.
[11] *Jahrb. f. Kinderh.*, 1911, lxxiv, 1 (by *J. Am. M. Ass.*).

child should be kept in bed and astringent and cauterizing measures should be applied after reduction. If these fail or if the prolapse is total, he advises resection of the sagging portion and suture.

Hypospadias

Hypospadias is that form of imperfect development of the urethra in which the canal terminates in an opening in its lower wall instead of extending to its normal termination in the end of the glans penis. There are three degrees of hypospadias: (1) *balanitic hypospadias,* in which the urethra opens on the lower surface of the glans or at the penobalanitic junction; (2) *penile hypospadias,* which occurs as penoscrotal and scrotal hypospadias, in which the canal opens on the under surface of the penile urethra, usually at the penoscrotal angle; and (3) *perineal hypospadias,* in which the urethra terminates in front of the triangular ligament and opens in the perineum. Thus hypospadias always occurs in front of the cut-off muscle, and, no matter how extensive it may be, the patient has control over the escape of urine. Hypospadias at the penoscrotal angle is more common than the perineal variety, and most frequent of all is balanitic hypospadias. That part of the urethra lying between a hypospadial opening and the meatus is usually represented by an irregular gutter.

The hypospadic urethral orifice is always contracted. With penile hypospadias there is usually some downward curvature of the penis, and not infrequently adhesion of the penis to the scrotum.

With perineal hypospadias the scrotum is bifid, and the penis is usually very imperfectly developed, imperforate, and looks like a large clitoris. The bifid scrotum passes very well for a vulva. This is a common type of pseudohermaphrodite.

Etiology.—Hypospadias is due to arrest of development in a portion of the lower wall of the urethra, its lateral halves failing to unite in the median line. At two months the embryo has hypospadias normally. The scrotum has not yet united, and if natural development ceases here the last degree of hypospadias results. The hypospadias and the incurvation of the penis as well are due to adhesions about the site of urethral non-union.

Symptoms.—Balanitic hypospadias is unimportant; many patients have it without being aware of the fact, while the greatest inconvenience it produces is a slight imperfection in erection and a dribbling at the end of urination. With penile or perineal hypospadias, however, the patient may be forced to urinate in a squatting posture to keep from wetting himself, erection more or less imperfect, and there may be sterility from inability to throw the semen into the vagina.

An associated inconvenience is the necessity of enlarging the contracted meatus, in order to introduce dilating instruments, in case of stricture.

Treatment.—For *balanitic hypospadias* no treatment is actually necessary unless a meatotomy to permit the introduction of instruments into the urethra.

But if the patient demands radical operation, Beck's procedure should be employed.

For penile and perineal hypospadias operation is always required.

Unless hypospadias is accompanied by incurvation sufficient to prevent intromission, the decision as to whether the condition should be operated upon or not is a difficult one and should generally be answered in the negative. The urinary sphincters hold and the patient may even beget children. The success of a plastic operation for hypospadias is comparable to the success of a plastic operation for nasal deformity. It is a triumph of surgery rather than an imitation of nature.

But incurvation requires operation to mend it and the results of operation for incurvation are as generally successful as those for repair of the urethra are unsuccessful.

Few surgeons have operated upon a sufficient number of cases of hypospadias to advise us as to which is the preferable operation. If a patient insists upon operation for a balanitic hypospadias, the Beck operation may help him. But even to add a centimeter to the length of the urethra by this procedure requires that the canal be dissected back as far as the scrotum and most of the Beck operations have resulted in the producing of the very incurvation which it is the chief object of surgery to relieve.

For penoscrotal hypospadias Bucknell's operation probably is the best.

Epispadias

Epispadias is a fissure of the superior wall of the urethra with ectopia of the canal (Guyon). It is extremely rare. According to Baron, epispadias occurs once for 150 cases of hypospadias, but Marshall did not find a single case of epispadias in examining 60,000 conscripts.[12] The epispadias may be balanitic or penile, or the urethra may be entirely laid open. This complete epispadias is accompanied by exstrophy of the bladder. The epispadic orifice is large, and sometimes the finger may even be passed through it into the bladder. The prepuce forms a knob of erectile tissue below the glans. The penis is short and thick, or small and more or less deviated. It is usually adherent to the scrotum, sometimes practically buried in it. The pubic bones may be separated even when there is no exstrophy of the bladder, and there may be hernia of that organ without exstrophy.

Epispadias is, embryologically speaking, a displacement forward of the cloacal membrane which, if more marked, results in exstrophy of the bladder.

Symptoms.—The symptoms consist in the functional derangement of micturition, erection, and emission, as in hypospadias; but it is to be noted that incontinence of urine, which never complicates hypospadias, is usually the main

[12] Englisch (*Bull. méd.*, Paris, 1895, ix, 153) has reported a case of complete separation of the penis into lateral halves, each corpus cavernosum forming a penis by itself, and the urethra opening between them.

feature of epispadias, and this demands operation more insistently than even the most aggravated symptoms of hypospadias.

Treatment.—For the milder cases, uncomplicated by the loss of sphincter power, the counsel to bear their woes patiently is a good one. The methods employed to relieve this condition are tedious and fraught with failures.

Cantwell's operation seems to have superseded all others. Young has employed it successfully on a case with incontinence of urine.

CHAPTER XLI

INJURIES TO THE KIDNEY AND URETER; ANEURYSM OF THE RENAL ARTERY

SUBPARIETAL INJURIES—RUPTURE

Subparietal injury of the kidney is rare. Among 13,455 autopsies there occurred thirty-one instances of ruptured kidney (Morris). Among 198 cases of rupture collected by Tuffier, 136 occurred in adult men, and in only two were both kidneys injured. Two hundred and eighty-one of Küster's 306 cases were males. Of 272 in which the particulars are stated, 142 occurred on the right and 118 on the left side, twelve being bilateral (Morris). In a series of eighty-nine cases of contusion of the abdominal viscera the kidneys were injured thirty-five times. (Makins.) On the other hand, injury to the kidney is not often associated with lesions of any other of the abdominal viscera. The reason for this is obvious. The kidney may be ruptured by direct violence, in which case the force is applied from behind and is not calculated to reach the intraperitoneal organs. Or it is ruptured by the indirect violence of muscular strain, which also is calculated to injure only the kidney.

Fig. 120.—Ruptured Kidney.

The cause of injury to the kidney is usually trauma applied directly to the loin. Yet in some cases the occasion of rupture is a mere strain. Bugbee,[1] in an excellent discussion of the subject, mentions cases in which the trauma consisted in nothing more than a misstep or the cranking of an automobile.

The disproportion between the trauma and the resulting lesion of the kidney is truly striking. A man may fall out of a window and injure his kidney only to the extent of occasioning a brief hematuria; another falls over a pebble and by the violence of his muscular action tears his kidney to pieces. Children are peculiarly susceptible to renal injury, yet the most a prize fighter can do is to produce a slight hematuria by his kidney blows. Doubtless, the lack of perirenal fat makes the children especially vulnerable.

The mechanism of rupture is doubtles that the kidney bursts like a bag full

[1] *Ann. Surg.*, Oct., 1916, p. 459.

of water through the incompressibility of its fluid contents, blood (Küster), or by the sudden impact of the ribs against it, when the injury is due to indirect violence.

The chronically inflamed kidney is rendered resistant to injury by the framework of scar throughout its parenchyma. Yet the points softened by stone or tuberculosis are vulnerable to very slight injury. Thus I have reported the rupture of a calculous kidney by a golf stroke. But note that the extravasation of urine about a calculous kidney is usually due to rupture of the ureter or pelvis by tension and infection, much as the appendix ruptures.

Finally one has to contemplate the so-called blood-cysts of the kidney (*cf.* Del Valle[2]). These rare large accumulations of blood under the capsule, of which I have seen but one (Israel reported one and Albarran twenty-four) are evidently the result of trauma so slight as to escape notice.

Pathology

The kidney usually ruptures in several points. The tears are irregular branched fissures in the parenchyma. These involve (*a*) only the parenchyma or (*b*) also the fibrous capsule, or (*c*) also the pelvis, or (*d*) all three.

If the parenchyma alone is involved "blood-cyst" of the kidney results. No gross blood is noted in the urine, there is no perirenal extravasation.

If the fibrous capsule is ruptured but the pelvis remains intact, perirenal hematoma results but not hematuria.

If the fibrous capsule is widely torn and the pelvis or calices only slightly lacerated, blood escapes both into the urine and into the perirenal space but no urine is extravasated about the kidney. This is the usual clinical condition.

If both are widely torn blood and urine mix in the perirenal space and in the discharges as well unless clots block the ureter (or this is torn across). Hence when there are other signs of grave renal injury and no blood in the urine this is rather a grave sign.

Associated Lesions.—Cases of rupture of the perirenal fat without injury to the kidney have been reported. They are rarely reported since most surgeons are aware of the necessity for conservatism in opening a loin unless the symptoms really require it.

Rupture of the kidney in children is often associated with rupture of the peritoneum as well, since the perirenal fat is undeveloped and the peritoneum is close against the kidney. This is rare in adults.

Rupture of a main vessel is rare as are accompanying lesions of other viscera.

The Outcome.—If the wound heals without surgical intervention, the extravasated blood is usually absorbed, but the following lesions may persist: (*a*) blood-cyst within the capsule—indeed the major part of the secreting substance of the kidney may be reduced to a pulp and yet the lesion heal; (*b*) hydrone-

[2] *Prensa méd. argentina,* 1917, iv, 280.

phrosis, due to blocking of the ureter; (*c*) pseudohydronephrosis, the collection of urine being chiefly in the perirenal space; (*d*) infection of a mildly injured kidney, resulting in pyelonephritis; (*e*) grave infection resulting in perinephritic infection, urine usually mixed with the pus. Of these the most common are the total spontaneous repair or the sequent pyelonephritis.

Symptoms

The clinical manifestation of rupture of the kidney may be quite as disproportionate as was its cause. Shock, even abdominal shock, is largely a subjective matter. Patients with grave renal injuries have been known to go about as though they had nothing more than a sprained back, until they collapsed from loss of blood. Yet as a rule the shock is a measure of the visceral injury and, if this is severe, dominates the scene.

Locally the pain, tenderness, ecchymosis and swelling call attention to the site of injury.

Hematuria.—The passage of bloody urine after a contusion of the loin is the most characteristic symptom of ruptured kidney. Yet the hematuria may occur when the kidney is not ruptured,[3] and, on the contrary, there may be no hematuria. Thus the blood cannot reach the bladder if there is (1) subcapsular rupture, (2) occlusion of the ureter by clot, or (3) avulsion of the kidney from the ureter. Yet hematuria is a feature of at least 80 per cent of cases.

The course of the bleeding is very irregular. The blood usually flows freely for several days, and then ceases, either because the hemorrhage has stopped, or because the ureter becomes obstructed by clots. Blood-cells and albumin may persist in the urine for many days, and recurrence of bleeding is not uncommon. Exceptionally there is no hematuria for the first few days. The blood passed is usually sufficient in quantity to dye the urine a deep red; yet, as a rule, the actual amount of blood thus lost is not alarming.

Disturbance of Renal Function.—During the first day after the injury there is oliguria, perhaps anuria, from shock. Continued anuria indicates rupture of both kidneys, or else incapacity of the opposite kidney, if there be one, to act, and is therefore an indication for immediate cystoscopic investigation. But usually a polyuria replaces the primary oliguria, and lasts two or three days longer. There may be reflex dysuria or retention. The urine may become purulent as well as bloody.

Tumor.—The extravasation of blood and urine about the kidney may develop a tumor in the loin. This swelling may appear immediately, or its advent may be delayed several days, or no tumor may ever appear. The tumor is usually quite diffuse, filling the whole loin and perhaps extending even to the groin.

[3] Morris gives a long list of exceptional causes of hematuria after contusion of the loin, such as slight contusion of the kidney, renal congestion, thrombosis of the renal vessels, stone, malaria, tumor of the bladder. But the only feature of clinical importance is the persistence of bleeding. Continued grave bleeding from whatever cause, demands operation.

The swelling is elastic, but fluctuation cannot be made out. General abdominal tension from the accumulation of flatus and from the tenderness of the bruised parietes may obscure a large perirenal hematoma, unless bimanual simultaneous comparison of the two loins is made.

Pain.—The pain of a ruptured kidney is an inconstant symptom. The superficial contusion produces local pain and tenderness; the passage of clots through the ureter may evoke renal colic, and the distention of the kidney, or of the loin, may produce an active pain radiating chiefly to the groin and testicle, and perhaps causing retraction of the latter.

Course of the Disease

The Injury Is Slight.—There is little or no shock, local tenderness and rigidity, a temporary oliguria, and hematuria. After a few days the urine becomes quantitatively and qualitatively normal. No notable tumor appears in the loin, and the patient is well within ten days or so.

The Injury Is Apparently Slight.—But the symptoms, instead of growing less, or perhaps after an apparent remission, become more severe. A perinephritic mass develops, pulse and temperature run high, the digestive functions are not properly established, the abdomen remains distended and tympanitic, there is constipation, anorexia, perhaps vomiting, the tongue is dry, the patient listless and irritable. This clinical picture indicates progressive urinary toxemia and sepsis, and calls for prompt drainage if the patient is to be saved. The presence of pleurisy, pneumothorax, or edema of the lung must not be overlooked.

The Injury Is Severe.—At first the patient is dazed, unconscious, or in a state of collapse. Hematuria and hematoma develop rapidly. He may fail rapidly and die of shock, of internal hemorrhage, of suppression, or, later, of septic complications. Or the hematoma may be gradually absorbed or become infected.

The Injuries Are Numerous.—In the most serious cases the renal rupture is only one among several visceral injuries. Rapidly fatal intraperitoneal hemorrhage may occur from the kidney, liver, or spleen. The triple infliction of shock, hemorrhage, and peritonitis can be combated only by immediate abdominal section with slight hope of success.

Septic Cases.—No case, however mild, is free from the danger of infection until a month has passed. One of my patients developed a transient pyelonephritis three weeks after a slight renal injury. Most large perirenal hematomata suppurate unless operated upon.

Traumatic Hydronephrosis.—Exceptionally the hematoma becomes encysted, forming the so-called traumatic or pseudohydronephrosis.

Diagnosis

While slight injuries to the kidneys may be overlooked, especially if overshadowed by more important lesions of the other viscera, a kidney rupture of

any great significance always manifests itself by loin tenderness, rigidity and ultimately tumor, usually associated with hematuria and oliguria or anuria.

The cystoscope and ureteral catheter should never be employed, for fear of infection, until the decision to operate has been made and it is necessary to prove the condition of the opposite kidney. Exception may be made only for cases that will be clinically benefited by a diagnosis that can be established in no other way except by cystoscopy.

Treatment

The treatment of shock is of the first importance. Opium must be sparingly employed for fear of masking the symptoms.

The passage of a catheter into the bladder should not be considered, except for the evacuation of clots. Operative treatment establishes free drainage and is therefore preferable to instrumentation, for instrumentation is palliative at best. By it the symptoms are modified, but the essential features of the case—the hemorrhage, the function of the opposite kidney, the infection of the perirenal hematoma—are, to all intents, unaffected. Only by the knife can the surgeon reach these, and thus the momentous question in the treatment of rupture of the kidney is, whether and when to operate.

Immediate operation is required only when the patient fails to rally well from his shock. The symptoms of intraperitoneal hemorrhage or rupture of some of the other viscera will lead the surgeon to fortify the patient by a large transfusion, and then to operate, in the desperate hope of averting the fatal issue. My experience coincides with that of Michelson [4] who states that apart from laceration of the renal artery and vein, which may prove immediately fatal, the patients do not bleed to death. He reports thirty cases treated expectantly without a death from hemorrhage.

After the first shock is over expectant treatment may be continued on condition that the patient grows progressively stronger. Yet the surgeon must be ready to operate, and the patient and his friends prepared to submit, as soon as any favorable symptom manifests itself. The usual indication for operation at this juncture is continued hemorrhage, as evinced by the increasing anemia and growing tumor in the loin, for "it is not the visible loss of blood by the bladder, but the easily overlooked but far more dangerous bleeding into the perinephritic tissues, or into the peritoneal cavity, that should receive the chief attention" (Keen). Anuria persisting for twenty-four hours is an indication for immediate operation. Urinary antisepsis by hexamethylenamin and ammonium chlorid should be begun at once. If after two weeks the lumbar mass is as large as ever, it had better be drained to forestall perinephritic abscess. The occurrence of suppuration in such a mass can only be detected at its beginning by the rising leukocytosis.

[4] *Arch. f. klin. Chir.*, 1911, xcvi, No. 3.

The treatment of pyelonephritis resulting from renal trauma does not offer any peculiarities.

Although severe wounds in the kidney have been known to heal, the prospects of grave cases treated expectantly are not good. Thus, among 273 uncomplicated cases treated expectantly (Watson), 81 (30 per cent) died, and among 174 operated cases, 32 (18 per cent) died, while of the complicated cases treated expectantly, 31 out of 56 (60 per cent) died, and of the 59 complicated cases operated upon, 26 (44 per cent) died.

The Operation.—The surgeon employs the incision with which he is most familiar, as speed is all-important. The choice between the abdominal and the lumbar route depends upon whether any other visceral lesions are suspected. Though the abdominal route affords quicker control of the renal artery, the lumbar incision is habitually employed. If copious bleeding is encountered, the bleeding point is immediately sought for and if not found, the renal pedicle is hastily compressed with the fingers to control the hemorrhage. Then, after control of the retroperitoneal hemorrhage and toilet of the wound, the peritoneum is opened and explored for evidences of retroperitoneal injury, the peritoneum being closed again without drainage after any necessary repair within it.

The next question that arises is the viability of the kidney. If more than one-third of the kidney appears to have lost its blood supply, nephrectomy will be required; if less than one-third, the necrotic portion may be excised or if it is small, left undisturbed. There is little value in suturing ragged tears in the kidney substance. A tube drain will be left in the loin.

Decapsulation of the opposite kidney may help its function, if this is gravely impaired.

Secondary nephrectomy may be required if prolonged suppuration ensues.

WOUNDS OF THE KIDNEY

Wounds of the kidney (other than ruptures) are extremely rare. Even in military practice they are unusual. Tomsk[5] collected the reports from European sources for the World War of 210 renal wounds among 78,000 wounds; about one in 3,700. The United States Surgeon's Office reports 129 among 170, 841 battle casualties, 1 in 1,300. Our mortality was 58 per cent. Yet uncomplicated cases do well. Gorasch lost only three of his twelve cases treated expectantly and Stenfeld only 21 out of 125.

The symptoms and diagnosis present no special features.

Because of the infected wound or the presence of foreign bodies in the wound, partial resections of the kidney or other plastic operations are likely to fail.

Fedorof saved a number of kidneys by plugging a punctured or perforating wound with fat to check hemorrhage.

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[5] *Urologia*, 1923, Nos. 1-2.

ANEURYSM OF THE RENAL ARTERY

Lippens [6] collected twenty-three instances of aneurysm of the renal artery. This rare condition is always fatal unless the patient submits to operation. The aneurysm ultimately ruptures, causing a spontaneous perirenal hematoma.

The symptoms are tumor, pain, and rarely hematuria. It is remarkable that pulsation is rarely detected. Morris detected a loud systolic bruit in his case, but no thrill.

I have proven the diagnosis of a suspected case by aspirating free blood, and of two others by bruit.

The *treatment* is nephrectomy. The aneurysmal sac should be disturbed as little as possible until the pedicle is secured. Albert, Hahn, and Keen have operated successfully. A transperitoneal operation presents a better field for securing the renal vessels than does the lumbar route.

RUPTURE AND WOUNDS OF THE KIDNEY PELVIS AND THE URETER

Rupture.—Subcutaneous rupture of the ureter is very rare. The symptoms are those of rupture of the kidney. Bugbee (*loc. cit.*) has collected twenty-two cases. He advises immediate cystoscopy to distinguish the side injured, to determine the condition of the opposite kidney and, perhaps, to locate the site of injury. Operation immediately follows to drain the extravasated urine and save the kidney, if possible, by suture, or for nephrectomy.

Wounds.—Accidental wounds of the ureter are even more uncommon. Morris found only five reported cases, two bullet wounds, and quotes Otis's conjecture that these injuries do not come to the surgeon's notice because the trunk vessels are likely to be punctured.

Operative Injuries.—"The ureter is injured probably in from 1 to 3 per cent of all intraperitoneal operations upon the female pelvic organs. This accident is more common by the vaginal than by the abdominal route.

"The causes of these injuries are: (1) displacement or intimate involvement of the ureter by pathological structures in the pelvis, especially uterine and ovarian tumors; (2) congenital abnormalities; and (3) lack of care by the operator.

"The different kinds of ureteral injuries, stated approximately in the order of the frequency of their occurrence, are: (1) ligation, (2) clamping, (3) kinking (these three usually produce complete occlusion), (4) incision, (5) resection, and (6) destruction of blood supply. Complete obstruction may lead to the following results, named approximately in the order of their seriousness: Local—(*a*) infection—15 per cent, (*b*) fistula—24 per cent, (*c*) hydronephrosis —80 per cent, (*d*) general renal atrophy—less than 20 per cent in Barney's

[6] *J. de Chir.*, 1913, xi, 1.

series. General—(*e*) toxemia—very rare, (*f*) anuria—1.6 per cent, (*g*) no symptoms—21 per cent. The mortality of unilateral ureteral obstruction is 18 per cent. (W. Jones)" [7]

Ureterovaginal fistula results from obstetrical injury.

Symptoms.—If the ureter is tied off or otherwise occluded the uninfected kidney, after going through a preliminary period of congestion and slight dilatation, atrophies without dilatation. In such a case, if the opposite kidney is normal, the accident may never be recognized. If the kidney is infected acute pyelonephritis and pyonephrosis result. If both ureters are tied off, the complete anuria which results is symptomless up to the last moment, like calculous anuria.

If the ureter is divided and the accident passes unrecognized, an abdominal or vaginal urinary fistula is established. The patient may die of peritonitis but usually escapes.

Diagnosis.—Cystoscopy and urography establish the diagnosis.

Treatment.—In the early days of pelvic surgery nephrectomy was the only alternative offered to those women who were left with ureterovaginal fistulæ after hysterectomy. But in 1886 Schopf, Fritsch, and Tauffer each recognized at the time of operation that he had divided the ureter and proceeded to sew the ends together. Thus began the conservative surgery of the ureter.

The prevention of injuries to the bladder and the ureter during childbirth has been accomplished by the various devices whereby the obstetrician shortens labor or supplants it by cesarean section. The surgeon cannot do quite so well, for though he has learned to identify the course of the normal ureter in the pelvis and to avoid stripping it too freely from the peritoneum, and though he recognizes the usual deviations from the normal course that inflammation or carcinoma produce, yet this very knowledge may mislead by making him overconfident. Let him remember that the identification of the ureter at one point of its course does not give any notion of its situation after it has plunged into a mass of adhesions or carcinoma. Thus Hunner [8] says, "In the cervical growth which develops a large mass in the vaginal portion, the operator may find on exploring the pelvis that the broad ligament regions are entirely free from inflammatory reaction and, proceeding on the assumption that the case is an unusually easy one to handle, he may ignore the ureteral problem, only to find later that he should have proceeded, as in all cases of carcinoma of the cervix, to operate by the abdominal route, by isolating the ureters at the beginning of the operation. In this type of cervical involvement the mass vaults up beneath the broad ligaments and causes considerable displacement of the distal ureter without causing any of the inflammatory involvement so much dreaded and guarded against by the careful operator."

It has been suggested that catheterization of the ureter will sufficiently identify it to prevent injury during operation. That this is not the case is

[7] *Am. J. Obst.*, 1914, lxx, 329.

[8] Cabot's *Modern Urology*, 1924, Vol. II, p. 273.

shown by Sampson [9] who reports cases clamped over the catheter, breaking this and requiring its removal through a slit above.

In five of Sampson's cases the fact that the ureter had been ligated was discovered during operation. The ligature was removed and no harm resulted. In four others the removal of a clamp inadvertently placed on the ureter did no harm other than breaking the catheter, except that one required a single catheterization of the ureter to relieve retention and another was followed by vaginal fistula, opening three days thereafter and closing in three weeks.

Division of the ureter requires suture if the ends can be brought together without tension. Hunner has closed the divided ureter by end to end anastomosis successfully over a bit of ureter catheter used as temporary splint. Otherwise the ureter may be ligated or the kidney removed, or if the opposite kidney will not support life, ureterostomy must be performed into the skin.

If the injury has been overlooked at the time of operation, it is usually necessary to sacrifice the kidney.

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[9] Cited by Hunner.

CHAPTER XLII

WOUNDS AND RUPTURES OF THE BLADDER AND URETHRA

ALTHOUGH it is necessary to describe the lesions as though separate and distinct, injuries to the bladder and urethra often occur together, due to the same cause, be it a perforating wound, a fracture of the pelvis or a mere temporary "springing" of the pelvis which tears bladder and urethra without actually fracturing or dislocating the pelvic bones. Peacock and Hain [1] have estimated that the automobile is responsible for one-third of the injuries to bladder and urethra. They estimate the average hospitalization at sixteen weeks, the average disability almost two years.

WOUNDS OF THE BLADDER

Wounds of the bladder are not common, since the position of the organ protects it from ordinary accidents, inclosed as it is, when in a state of relaxation, by the bony pelvis. Excepting the violence done by cystoscopes, lithotrites, or during other operations, the bladder is but little liable to injury except when overdistended. Rising above the symphysis pubis it becomes exposed to incised, punctured, and gunshot wounds. Bullets and fragments of shell have entered the bladder without producing fatal consequences, and there formed nuclei for calculus, as have also portions of bone. But most bullet wounds are associated with wounds of the intestine, usually extraperitoneal injuries of the rectum, requiring repair; and fracture of the pelvis. Hence in war, such cases usually die before reaching the base hospital.

The symptoms of wounds of the bladder are comparable to those of rupture, plus an external wound. The prognosis depends upon the presence and severity of the complications, the availability of surgical assistance, and the position of the rupture, whether it is intraperitoneal or extraperitoneal.

Usually the diagnosis is suggested by the course of the projectile, proven by exploration. In an uncomplicated case I located the wounds of entry and exit by cystoscopy.

Treatment.—The treatment is immediate incision, suture of the bladder, and drainage of the external wound to prevent infection and secondary infiltration. If the case is not seen until infiltration has set in, wide incisions and drainage are necessary.

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[1] *J. Urol.*, 1926, xv, 563.

RUPTURE OF THE BLADDER

Rupture of the bladder may occur in the normal or in the diseased organ. A large proportion of ruptured bladders are in some measure diseased and, while it is practicable to distinguish as pathological ruptures the few cases in which it is reported that cancerous or gravely inflamed bladders have given way as the result of very slight traumata, it is equally true that cases are occasionally reported of rupture of an apparently normal bladder, when it was distended, by very slight muscular effort. I have seen two such cases, in which neither patient had any significant antecedent history of disease of the bladder; neither patient was drunk at the time the bladder was ruptured. The operation which saved the life of each did not reveal any lesion of the bladder other than rupture. Neither patient gave any history of injury.

Hence it seems unnecessary to invoke disease of the bladder as an accessory cause of rupture.

Distention of the bladder is the predominating, predisposing cause of its rupture. Drunkenness is the predominant predisposing cause of overdistention of the bladder and most of the ruptures due to falls or indirect violence have happened to intoxicated persons.

The empty bladder cannot be torn except by the introduction of instruments or by fracture of the pelvis. The overdistended bladder may, as already stated, be torn by very slight indirect trauma.

The bladder may be ruptured by trauma from within itself, notably by stone retention or surgical overdistention, by trauma during parturition, by fracture of the pelvis, by direct violence such as blows or kicks upon the lower abdomen, by falls which doubtless invoke an element of rupture by muscle strain or indirect violence, and finally, by mild muscle strain such as lifting a weight.

We distinguish intraperitoneal and extraperitoneal rupture of the bladder. The two are usually quite separate but may coexist; and one may also distinguish a very rare form of extraperitoneal rupture, termed subperitoneal, in which the laceration occurs in the subperitoneal portion of the bladder but is not sufficiently extensive to tear the peritoneum itself.

The mechanism of rupture of the bladder has been much discussed. The rupture may be a bursting as the result of pressure applied from without or from within, or it may be a laceration or avulsion due to disruption of the pelvis, or fracture.

The bursting ruptures, due to pressure from without, usually occur in the upper subperitoneal part of the bladder. The shape of the rupture is irregular and is determined by the direction of the muscular fibers as they tear apart. It is possible that the promontory of the sacrum acts as the point of counter-pressure when the full bladder is ruptured by a blow on the abdomen. The empty bladder is never ruptured by such a blow.

This bursting rupture may also be extraperitoneal. The avulsion rupture,

due to disruption of the pelvic ring with consequent tearing a hole in the bladder, is always extraperitoneal and may be associated with lesions of the deep urethra and of the rectum.

Symptoms and Course of Intraperitoneal Rupture of the Bladder.—If the patient is intoxicated, the immediate accident or even the blow or kick that causes it may escape notice. If not intoxicated, the blow or the strain occasions a sharp immediate pain followed by shock. This shock may be severe or may be so mild that the patient takes no great account of it. He gets home feeling a little groggy and recognizing a considerable hypogastric discomfort, but for the first twenty-four hours this is not severe. The discomfort tends to spread throughout the lower abdomen which becomes tender. But, in as much as uninfected urine excites only a mild peritoneal reaction, the rigidity and tenderness are not great unless the urine is infected and the patient developing a septic peritonitis.

In the meanwhile the bladder function is considerably disturbed. As a rule there is a great desire to pass urine and the effort produces either no result at all or only a small amount of bloody fluid. It is very exceptional that the rupture should be so small or so valvelike that the function of the bladder is but little disturbed.

After a day or more has gone by, there is a striking discrepancy between the amount of urine that has passed, the irritation of the bladder and the absence of a palpably distended bladder. The absence of this and the presence of bladder tenderness may be confirmed by bimanual palpation.

If the case is neglected the patient inevitably dies. Of those patients who do not die of shock or hemorrhage from associated injuries, the majority die of peritonitis which usually begins in the first ten hours and permits a survival of only a few days. A minority escape peritonitis and die of intoxication and uremia from the peritoneal resorption of urine. Such cases may survive as long as ten days.

Symptoms and Course of Extraperitoneal Rupture.—If the pelvis is fractured, the symptoms of this dominate the clinical picture, the bladder rupture adds only the hematuria, oliguria, dysuria, similar to those evinced by patients with intraperitoneal rupture of the bladder.

Bimanual examination of the patient with extraperitoneal rupture reveals the infiltration of the pelvic spaces both between the bladder and rectum and between the bladder and anterior abdominal wall, but of course it is impossible by palpation alone to make a complete diagnosis.

Some 25 per cent of extraperitoneal ruptures are said to recover without operation but many of these recoveries imply inadequate drainage of foci of pelvic suppuration and leave cystitis and various bladder fistulæ which require operation for their cure. The usual causes of death are immediate hemorrhage and shock or later thrombophlebitis, embolism, infection.

Diagnosis.—The diagnosis of rupture of the bladder is suggested by the history of an injury, the passage of blood from the urethra, the presence of

bladder discomfort and the absence of bladder distention, though the patient has been many hours passing little or no urine. All pelvic fractures should be suspected of having rupture of the bladder or of the urethra. If the patient passes considerable amounts of urine the diagnosis of rupture is established by the presence of blood in the urine passed.

The first instinct of the urologist is to pass a catheter in order to determine the character and amount of urine in the bladder. The catheter may be passed but only with the remembrance of Zuckerkandl's statement that peritonitis complicating intraperitoneal rupture of the bladder is usually attributed to the catheter. If the urethra is intact and the pelvic fracture does not prevent catheterization, the ruptured bladder may be expected to deliver urine and blood, usually very little urine.

One's next instinct is to inject a measured amount of fluid into the bladder in order to remeasure it as it flows back through the catheter in the hope that any leak in the bladder may be demonstrated by the discrepancy between the amount injected and the amount withdrawn. This procedure cannot be too strongly condemned. I have never known it to aid in the diagnosis and several times when it has been employed by my associates in Bellevue Hospital against my advice, the findings have been misleading. Either the return flow was the same as the amount injected and yet the bladder was ruptured or the return flow has been distinctly less than the amount injected and yet the bladder was not ruptured.

If a conclusion as to the rupture of the bladder cannot be reached by the usual physical signs and the presence of blood in the urine, the injection test should not be employed but the patients should be cystoscoped in Fowler's position with as small an amount of saline solution as possible as the medium for cystoscopy. This examination will reveal the tear in the bladder wall. Cystoscopy should not be performed if the diagnosis can be made without it.

The diagnosis that the rupture is extraperitoneal is favored by signs of pelvic fracture, evidence of contusion and infiltration in the prevesical space and in the space between rectum and bladder, and the absence of signs of peritonitis. Intraperitoneal rupture is suspected on the basis of findings opposite to these.

Rupture of the kidney may occur from an injury of such severity that one cannot be sure the bladder is not ruptured. Rupture of the kidney habitually interferes with the bladder function very little except by the accumulation of blood-clots. Bimanual pelvic examination may be depended upon in contrast to palpation of the loin to provide the differential diagnosis.

Rupture of the urethra is distinguished by rectal touch which discloses perineal and ischiorectal hematoma or infiltration and, given the usual retention, results in distention of the bladder which can be distinguished by bimanual palpation.

Rupture of the bladder and of the urethra may occur simultaneously.

Treatment.—The treatment of rupture of the bladder is operation performed

at the earliest possible moment. Rouvillois and Ferron report nine cases operated upon in the first twelve hours with one death; nine in the second twelve hours with two deaths; sixteen on the second day with seven deaths and twelve thereafter with one death. These figures indicate that immediate operation will save eight or nine out of ten patients and the few patients who pass the third day without operation and without being manifestly moribund are likely to survive if properly treated.

WOUNDS OF THE URETHRA

The urethra may be wounded by traumatism from within or from without. External wounds only concern us here. Internal wounds, whether produced by foreign bodies, by instrumentation, or by internal urethrotomy, find more appropriate exposition under their respective titles.

Punctured Wounds.—The prognosis of a punctured wound of the penile urethra is generally good. For simple punctured wounds a single irrigation of the wound and the urethra with an antiseptic solution, e.g., acriflavin, 1 : 1,000, followed by careful catheterization for each urinary act during the first one to three days, should result in a cure. If the puncture is merely the central point of a laceration or a contusion of the canal, the treatment must be carried out as laid down for these conditions. Complicating suppuration, infiltration, or fistula requires appropriate treatment, as indicated below.

Incised Wounds.—Clean-cut wounds are very rare in the perineum; they usually implicate the penile urethra, the corpus spongiosum, and often some portion of the corpora cavernosa. The complications to be feared are hemorrhage, periurethritis, traumatic stricture, and fistula. Wounds in the scrotal region are most likely to be followed by severe inflammation, while obstinate fistula is the usual complication of wounds of the penile urethra. The prognosis of stricture, on the other hand, depends on the extent rather than on the situation of the lesion. Stricture does not follow longitudinal wounds of the urethra, but results rapidly from any transverse or oblique wound. When the anterior urethra is completely severed, the cut ends retract within the corpus spongiosum to such an extent that it may be difficult to bring them together again.

Treatment.—Immediate suture with suprapubic drainage as for rupture.

RUPTURE OF THE URETHRA

This includes all contused and lacerated wounds of the canal inflicted from without, and is by far the most common urethral injury, the lesion usually involving the bulb, rarely the pendulous, and still more rarely the posterior urethra.

Etiology.—1. *The pendulous urethra* is practically safe from injury except during erection; but in that condition it is liable not only to extensive injury, as

in fracture of the penis and breaking a chordee, but also to slight tears by bruising during coitus—injuries which, though scarcely noted at the time, may result in stricture.

2. *Rupture of the bulb* is usually the result of direct violence—falling astride of a beam or some such hard object, in 82 per cent (Kaufmann), a kick upon the perineum, or the jolting of a rider onto the pommel of his saddle.

The mechanism of rupture of the bulb has provoked much dispute. When the force is applied obliquely, the canal is crushed against the ischiopubic rami; when from in front, as, for instance, in a fall with the body bent forward, the impact is against the front of the pubes (Oberst, Terrillon); while in certain cases, where the force is applied directly from below, the urethra is probably torn at the sharp edge of the suprapubic ligament (Ollier and Poncet). It is upon this last theory that differences of opinion persist.

3. *The posterior urethra* is torn by indirect violence with fracture of the pelvis. The membranous urethra is commonly involved, being torn with the triangular ligament, while the prostatic urethra is spared in all but the most extensive fractures. When the posterior urethra is ruptured and there is no fracture, the integrity of the pelvis is attributable to its elasticity. The bones are but sprung, the urethra torn.

Pathology.—The trauma which ruptures the urethra generally spares the surrounding soft parts. The skin and the muscles are not torn, and the superficial aspect is, frequently enough, that of a mere bruise or abrasion.

The canal itself may be merely bruised, or more or less completely torn asunder. In the posterior urethra complete laceration is the rule, the canal being broken, as it were, in the grip of the triangular ligament. In the bulb laceration through part of the circumference of the canal is the rule; but the roof is usually spared—a point of considerable importance in subsequent catheterization. In the anterior urethra the milder injuries consist in mere interstitial hemorrhage [2]—contusions, as it were—of the corpus spongiosum, with perhaps slight lacerations of the mucous membrane or of the sheath of the spongy body.

Symptoms.—The cardinal symptoms of injury to the urethra are pain, tenderness, bleeding, interference with urination, and tumefaction.

The pain is sharp and occurs at the moment of rupture. It may be the only symptom of interstitial rupture due to a jar to the erect penis. As it abates rapidly the patient may pay but little attention to it, though even a slight injury may lay the foundation for traumatic stricture. The pain recurs with each act of urination for a longer or shorter time, according to the gravity of the injury and the temperament of the person.

Tenderness exists primarily at the point of injury and later in the course of inflammation.

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[2] The possibility of this condition, as well as its clinical importance, has been warmly debated. Baron (*Presse méd.*, 1898, i, 250) sums up the evidence at hand, and shows that a simple contusion, without any break in the mucous membrane, may perfectly well be the starting-point for traumatic stricture.

Bleeding from the meatus is a constant symptom. It is lacking only in the rare cases in which the mucous membrane is uninjured. It occurs quite independent of urination, as urethrorrhagia, its quantity not indicating the severity of the lesion. The unbroken skin usually prevents external hemorrhage, though a hematoma of some size is not unusual. Hematuria combined with urethrorrhagia indicates an injury to the posterior urethra.

The disturbance of urination varies from the hesitancy excited by the pain of the milder cases to complete retention. This latter, indeed, is the usual condition, and is due to contraction of the lacerated urethra and to spasm of the cut-off muscle, rarely to hematoma of the corpus spongiosum.

Tumefaction, primarily the effect of hemorrhage, secondarily of urinary infiltration and suppuration, follows the fascial spaces. The tumor after injury to the pendulous urethra is usually a circumscribed one within the corpus spongiosum, but may follow the course of a perineal infiltration and extend throughout the scrotum and penis. Effusions within the triangular ligament are retained there to form a tense perineal tumor, which may burst either forward or backward, while injury to the prostatic urethra leads to infiltration of the ischiorectal and pelvic spaces.

Diagnosis.—The diagnosis of the extent of injury is not easy. Immediate interference with urination, which always follows complete rupture, may be caused by spasm or by retained clots. Catheterization, impossible if there is complete rupture, may fail even in milder cases. It is sufficient, however, for practical purposes, to diagnose the severity of the case according to the symptoms, as indicated below. Diagnosis of the position of the injury may be made with a fair degree of accuracy from its etiology and the location of the tenderness and tumor. The presence of urethrorrhagia, while establishing the existence of rupture of the urethra, does not exclude rupture of the bladder.

Course and Prognosis.—Guyon's classification is convenient as offering the most precise indications for treatment. It is as follows:

1. Mild injuries to the pendulous urethra, in which the trauma is succeeded by a sharp pain, slight bleeding, and a few painful urinary acts, are not likely to be followed by any serious consequences, except traumatic stricture, which is almost inevitable.

2. Moderately severe injuries to the pendulous urethra are characterized by free bleeding, painful and impeded urination, and a hematoma of some size. The chief danger here lies in infiltration and periurethral suppuration and later traumatic stricture.

3. In the severe injuries and in most perineal cases complete retention is the prominent symptom. It can rarely be relieved otherwise than by external urethrotomy.

In any case traumatic stricture may be predicted—a condition formidable both in its rapidity of onset and its rebelliousness to treatment (see Chap. XXI).

The immediate mortality from rupture of the urethra is low. Terrillon records 12 deaths in 170 cases, chiefly from uremia, septicemia, and hemorrhage.

Treatment.—1. For mild injuries to the pendulous urethra expectant treatment should be employed. Rest in bed, and the internal administration of hexamethylenamin suffice. Catheterization is unnecessary and absolutely contraindicated. Extravasation or suppuration must be met by prompt incision. Three days after the symptoms have subsided the patient may be pronounced free from all dangers except stricture, against which he must be warned. The contraction usually begins within six weeks of the time of injury. After three months a sound should always be passed.

2. Moderately severe anterior injuries represent, in a general way, slight lacerations, in which one may hope to avoid infiltration by preventing any contact of the urine with the wound. A rubber catheter should be tied in. Sounds should be passed after two weeks to prevent stricture.

If seen after suppuration has taken place and fistula has been established, one may be wary in prophesying good results from any attempt at a plastic operation. The distensibility of the corpus spongiosum cannot be reproduced and the fistula often cannot be closed. The principles of operation are preliminary suprapubic derivation of the urine and suture without indwelling catheter. I like to irrigate the urethra with 1 : 1,000 acriflavin before operation and saturate the wound with the same thereafter.

3. Perineal rupture demands immediate drainage. Suprapubic derivation of urine, V-shaped incision of the perineum, evacuation of the clots, trimming of torn surfaces and suturing of the urethra without indwelling catheter and with a widely open perineum.

If seen after suppuration has occurred, several operations will probably be required. The first to drain the periurethral and perineal abscesses, the second for the closure of perineal fistula by suprapubic derivation of the urine and resection of the perineal urethra.

URETHRORECTAL FISTULÆ

Urethrorectal fistulæ are very rare. They commonly arise from the prostatic urethra. They are caused by trauma (usually surgical) abscess of the prostate, tuberculosis, or malignant disease. Tuberculous and cancerous fistulæ are quite incurable and need no treatment. Traumatic and inflammatory fistulæ, on the other hand, commonly recover. I once opened a prostatic abscess into the rectum only to find that it had just burst into the bladder. The resultant fistula healed in four weeks. I have thrice opened the rectum during prostatectomy. Each time the fistula healed spontaneously. But the fistula that does not heal in three months will never heal spontaneously.

Perineal prostatectomy continues to occasion urethrorectal fistula from time to time, even in the best qualified clinics. Young advises that if the rectum is opened the operation by perineum should be discontinued and suprapubic drainage established. The operation for fistula is described elsewhere.

CHAPTER XLIII

BILHARZIASIS; ECHINOCOCCUS; ACTINOMYCOSIS

BILHARZIASIS OF THE BLADDER

The *Schistosomum hæmatobium* is the cause of the bladder infection. This parasite is developed in water as a miracidium which enters the body of a snail as intermediate host. Within the snail the sporocyst is developed in the liver from which are discharged the embryos which are pathogenic to man. These are taken in with a drink of water. It is believed that they can enter the body through any mucous membrane and that those that survive penetrate the mucous membrane of the throat or mouth and those that reach the stomach are destroyed by its acid contents. The embryos are carried to the portal vein where they develop and mate. The united pair then proceeds down the vena cava to the bladder where, in one of the vesical veins, the female lays her eggs which penetrate the wall of the bladder and are ejected in the urine to begin the cycle once again.

Bilharziasis is so-called because this parasite was discovered by Bilharz. The disease is very prevalent in Egypt and cases are found all over Africa and even as far afield as Japan, Siam and Greece.

It is believed that the disease is not seen in the United States excepting by direct importation.

The bladder lesions of the disease are granulomata surrounding the parasites in the vesical veins and elsewhere on the bladder small tuberclelike projections, ulcers where the ova pierce the mucous membrane and secondary lesions of villus formation, cystitis, incrustation. The granulomata are said ultimately to undergo malignant change. The inflamed and incrusted bladder wall contracts. The patient does nothing but urinate in agony.

The symptoms begin with a chronic hematuria, usually with an increase in the blood at the close of urination. Later the symptoms of cystitis appear and gradually dominate the situation.

The cystoscope shows in the early cases lesions that suggest papilloma and small miliary papules described as whitish or yellowish. Later the lesions closely resemble those of infiltrating carcinoma with secondary infection. The bladder is palpable as a thickened contracted mass.

The diagnosis is made by discovery of the oval ova. These are excreted in great number, four thousand having been counted from one patient in one day. The living ova are translucent; the dead ones opaque. The distinction is important for in the early curable cases only the translucent ova are found in the

urine, whereas in the old cases with grave secondary lesions, even stone or carcinoma, most of the ova are not translucent.

The treatment is by tartar emetic. This must be sterilized in the autoclave. It is given intravenously in doses beginning with ½ grain and increasing to 1½ grain, three times a week until no more living ova have been seen for a week. The lesions due directly to the infection will heal as the living ova disappear but, as Diamantis of Cairo justly remarks, the disease may clinically be divided into three stages, in the first of which the purely parasitic lesions are absolutely curable, in the second of which the sclerotic lesions respond far less well to the treatment and, in the third stage of which, with a thickened contracted bladder or with stone or tumor, no results can be expected from treatment.

ECHINOCOCCUS CYST OF THE KIDNEY

Although echinococcus (hydatid) cysts of the kidney occur in only about 1 per cent of all cases of echinococcus infection, the renal lesions usually occur without lesions of other organs. Thus, among forty-three cases collected by Nogueira,[1] only five had lesions in other organs. Exceptionally the lesion is bilateral. Nogueira had one bilateral case.

The cyst grows silently, destroying the kidney by pressure as it increases in size.

The period of latency may continue for from fifteen to thirty years.

The symptoms, if the cyst does not connect with the kidney pelvis, consist of pain from tension upon the kidney or pressure upon the adjoining organs and tumor in the loin. When the cyst bursts into the pelvis, the patient notices the passage of the cysts which are like flabby, deflated, white grapes. Hematuria may occur, pyuria and fever are apparently associated with mixed infection.

The diagnosis may usually be made, if the condition is suspected, by the eosinophilia, the complement fixation test and the passage of cysts in the urine. But habitually the passage of cysts is overlooked and many cases are operated upon under the diagnosis of tumor.

Treatment.—The tumor grows to a great size and two-thirds of the cases have been attacked by the transperitoneal route (26 operations—7 deaths). The lumbar route seems to give a lower mortality (17 nephrectomies—2 deaths), perhaps because the smaller tumors are attacked in this way.

The choice of operation is partial nephrectomy for cysts localized in one end of the kidney, marsupialization for the largest cysts, nephrectomy for the remainder.

Marsupialization (nephrostomy) will cure those cysts that have not become infected and that do not communicate with the renal pelvis. Therefore this operation upon a large cyst implies the prospect of permanent fistula or secondary nephrectomy.

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[1] *Urol. & Cutan. Rev.*, 1917, xxi, 241.

ACTINOMYCOSIS

Actinomycosis has been reported as affecting the kidney and the bladder. Cecil and Hill [2] have collected eleven such cases. The renal lesion resembles the later stages of caseous tuberculosis or necrotic neoplasm. The gross lesion of the bladder is an ulcerated one. Lesions of the disease have also been reported upon the skin of the genitals, in the testicle and in the ureter. The bladder and kidney cases are habitually diagnosed as infection, rarely as stone or tuberculosis. The diagnosis when made before operation has been founded on the discovery of the organism in the urine.

Patients have been improved by removal of the kidney or of the testicle but the treatment of the disease itself is not satisfactory.

SYPHILIS OF THE KIDNEY

The pathologist recognizes both syphilitic nephritis and syphilitic gumma of the kidney. Wile has reported the passage of spirochæta through the kidney and its recovery from the urine.

The clinical diagnosis of gumma of the kidney seems not to have been made during life, excepting at the time of operation when the knowledge of the patient's infection and the discovery of multiple gummy lesions in a kidney, operated upon for tumor or tuberculosis, has encouraged the surgeon to leave the kidney in place and cure the lesion by systemic treatment. Israel and others have reported instances of nephrectomy and the discovery after operation that the kidney was syphilitic. I have never seen a case of syphilis of the kidney or of the bladder.

SYPHILIS OF THE BLADDER

The lesions described are either secondary or tertiary. The secondary lesions are said to consist in multiple erythematous spots, yellowish papules, shallow ulcers. Corbus has described a case which showed syphilitic vegetations.

The tertiary lesion described is a chronic irregular ulceration. Corbus [3] has described a case of palpable thickening of the bladder wall and diffuse infiltration of the bladder wall disclosed by cystotomy.

If the diagnosis is made, the treatment is systemic. I have never made the diagnosis.

SYPHILIS OF THE URETHRA

Chancre of the urethra may be large enough to be felt as a nodule but as a rule it is not recognized. Chancre has not been described in the deep urethra.

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[2] *J. Am. M. Ass.*, 1922, lxxviii, 575.

[3] Cabot's *Modern Urology*.

The lesion is usually near the meatus and may give a slight urethral discharge, little pain. The urethroscope reveals a hard ulcer. Fistula and stricture are said to ensue. I have not seen them.

The diagnosis of urethral chancre is rarely made unless the symptoms of discharge and bleeding excite enough interest to call for urethroscopy or the pain and the infiltration are called to the patient's attention. I have never seen a case excepting retrospectively, *i.e.*, when one discovers the chancre in looking for the primary lesion of a patient suffering from secondary syphilis.

Gumma is said to produce a urethral discharge and to result in fistula. I have not seen it.

CHAPTER XLIV

PRELIMINARIES TO UROLOGIC OPERATIONS; THE RETAINED CATHETER

POSTOPERATIVE RENAL DEFICIENCY

Preservation of the renal function is the urologist's first care. For a general surgeon to lose a patient by unsuspected postoperative renal deficiency is no more shocking than that his patients should develop unsuspected prostatic retention after operation, or that their postoperative cystitis and pyelonephritis should prove such a pest. But these are the urologist's province. He must be aware of them.

Now the special care of the operating urologist is the renal function. This is the center toward which point all his special precautions: decompression, diuresis, choice of operation and of anesthetic, and the rest.

What happens to the renal function after operation—any operation, but especially after an operation upon a kidney?

Enthusiasts speak of certain anesthetics as though they protected the patient from all the ill effects of operation. Study of the renal function after operation explodes this fallacy. Whatever the anesthetic used, however unimportant the operation, there always results a diminution of the renal function, expressed by the diminished output of urine, and of phthalein, if this is measured. This is so familiar we take no notice of it. But if we examine the urine passed the day after operation, we shall find it not only diminished in quantity but also to contain casts, albumin, often blood-cells.

Acute postoperative renal congestion is the rule, not the exception. To minimize it we take certain precautions before, during and after operation.

Before, as well as after, operation, diuresis, drainage, decompression, may be requisite.

During operation, choice of anesthetic and technic, calculated for as much speed as is compatible with safety, are general requirements. If the operation is itself renal, delicacy and speed are doubly necessary. The kidney will be operated upon without lifting it out of the loin, if practicable. The operation will be so planned as to spare the renal parenchyma from trauma by bruising or cutting it or by prolonged compression of its vessels.

And we shall not forget the paradox: It is safer to operate upon a patient with well kidneys than with sick ones, but it is safer to operate upon a sick kidney than upon a well one. The paradox sounds ironic. It is not so meant. A kidney with uninflamed parenchyma demands the surgeon's respect far more

than an inflamed one. This for two reasons. In the first place, the function of the kidney is impaired by operation in direct proportion to its freedom from infection before operation. The less inflamed the kidney, the greater its reaction to the operative trauma.

In the second place, the operation is undertaken with the understanding that the opposite kidney has a better function than the one operated upon, with only a few exceptions. This opposite kidney is perhaps bearing substantially all the excretory function. If so, removal of the functionless kidney is not an attack upon a vital organ but upon an obnoxious tissue. It involves no upset of the renal balance. But the removal of a substantially normal kidney, or even the operative trauma that temporarily incapacitates such a kidney, suddenly demands of its fellow not only that it withstand the acute renal congestion common to all operations, but also that it take on at this very moment of congestion a double excretory burden.

Compare, with this in mind, the postoperative course of nephrotomy for stone and nephrectomy for tuberculosis. Why is the latter the less dangerous operation? Why is convalescence from it so much less stormy? In part, at least, because the renal function is relatively more impaired by tuberculosis than by stone. And comparison of the postoperative experiences of tuberculous or stone bearing patients, one with another, will amply illustrate the safety and comfort of those whose operated kidney had lost all function, compared with those whose operated kidney was relatively normal.

Simultaneous bilateral nephrolithotomy on uninfected kidneys in a period of calm is almost sure to be fatal. Simultaneous bilateral pyelolithotomy in the first two days of calculous anuria is almost sure to be successful.

And now a word as to the clinical picture of postoperative renal deficiency and its treatment. The picture is familiar enough. If the kidney is uninfected, one notes the diminished output of urine, the impairment of phthalein excretion, the nitrogen retention. If there is infection, add leukocytosis and fever.

The treatment is dilution, drainage being assured, by forcing fluids. Hence the routine use of hypodermoclysis, as much as 500 c.c. twice a day if necessary, and Murphy rectal drip, until the patient is able to resume taking fluids.

The value of decapsulation for the relief of the tension of acute nephritis has never been accurately estimated. Decapsulation apparently does no harm to the kidney and should therefore be done whenever nephrotomy is performed. But should it be considered as a treatment for desperate cases of postoperative suppression of urine? It certainly should. Puerperal eclampsia has been relieved by decapsulation and one may count upon it to relieve acute renal insufficiency due to renal suppuration. If all else fails, it should be tried as a treatment of postoperative renal insufficiency.

Kuemmel [1] even goes so far as to advocate decapsulation of one kidney, if its function is subnormal, before operation upon its fellow. He cites two cases,

[1] *Ztschr. f. Urol.*, 1924, xviii, 633.

one of tumor, one of unilateral tuberculosis. Preliminary renal function tests revealed in each instance a low function of the opposite kidney. Preliminary decapsulation was performed and a month later the function of this kidney had greatly improved and the nephrectomy was successfully performed. He attributes the improvement of function by decapsulation to the resulting sympathectomy rather than to the mere relief of tension, but whether this interpretation be correct or not, the alleged result is worthy of consideration.

PREOPERATIVE DIAGNOSIS

The pathological conditions in the urinary organs of a patient who is about to submit to operation are often both multiple and complex. A patient with an enlarged prostate, for instance, may have both stone and tumor in his bladder; I once came upon one of my assistants endeavoring to do a litholapaxy under these circumstances. Or he may have a diverticulum; if so, the removal of his prostate affords little relief. Pain with blood seen issuing from a ureter, with an x-ray shadow showing a stone on that side of the pelvis, might seem sufficient for a diagnosis of renal or ureteral stone. So it did in one of my cases; but the stone was in the appendix and there was renal tumor. When a patient passes a great deal of blood in the urine and has a very large kidney there seems little question but that the blood comes from that kidney; yet in one of my cases that had no pus whatever in the urine this free bleeding came from an ulcer on the papilla of a small tuberculous kidney whose fellow was hypertrophied but otherwise normal. A pain in the side preceding a calculous anuria would seem to justify operation upon that kidney. I once followed this suggestion and, although I came upon a diseased kidney, at the postmortem examination the opposite kidney was found acutely obstructed by a stone in the orifice of its ureter. Had I operated upon the other side as well the patient would have been saved. A patient with advanced pulmonary tuberculosis and pus and tubercle bacilli from one ureter might be expected to have a tuberculous kidney. Yet from one such patient I removed a kidney containing the largest stone I have had to deal with, while the tuberculosis was a wee secondary lesion. Another such, proven by guinea-pig, had nothing worse than a movable kidney.

The tale could continue indefinitely. The moral would ever be: The examination was not complete. Or one might begin at the boastful end, and arrive at the same conclusion. But the conclusion is a trite one. We are not perfect diagnosticians and never shall be. But the urologist is especially favored in that his diagnoses permit him to study fully the outline as well as the function of the urinary organs. By means of urography and renal function tests he becomes intimately acquainted with physiology and gross anatomy; and since his pathological problems are most of them reducible to terms of retention and the distention and interference to function resulting therefrom, he may look to make his diagnosis rounded as well as complete. Each part should complement its fellows. Thus a shadow in the radiogram may look like a ureteral stone.

In that case a complete diagnosis will include proof that the kidney above has appropriate diminution of function, that the ureter surrounds the stone and that the urinary passages above the stone are appropriately dilated.

The preoperative diagnosis must comprehend not only the *general condition and what may be done to better it to withstand the operative shock, but also and especially a sufficient number and variety of mutually supporting diagnostic data to depict precisely the gross anatomy of the organ to be operated upon and to estimate its function.*

PREPARATION FOR OPERATION

The special preparations required before operations upon the urinary organs center upon the heart and the kidneys.

If the patient is past middle life the heart merits the best diagnosis available, and even more especially the best therapy. Drugs are limited in their usefulness by the impairment of renal function. Our patients reach digitalis saturation much quicker than the internist expects them to. It is especially important to lean as little as possible upon digitalis and to rely upon graduated exercise, which in this case depends upon the intelligence of the nurse in getting the patient out of bed, to get the heart ready for operation. Our prostatectomy records repeatedly illustrate the necessity for deferring the final operation not only until the patient has had his functions stabilized but also until he has convalesced to the extent of being able to walk about quite freely without fatigue.

Impaired kidneys must be stabilized before operation by decompression, drainage and diuresis (see Chapters XI, XII).

The tongue should no longer be dry, the nocturnal polyuria should not exceed 750 c.c., hemoglobin should be above 60 per cent.

Temperature, blood-pressure, urine output, phenolsulphonephthalein output and blood chemistry should be stabilized at the best level attainable.

The heart should be strengthened by graduated exercise until the patient can walk about quite freely without fatigue.

CHOICE OF ANESTHETICS

Of the many benefits for which suffering humanity should thank the urologist not the least is the improvement in the understanding of the problems of anesthesia which has taken place during the last twenty years. For the aged patient with impaired renal elimination, upon whom the urologist is so often called upon to operate, requires more care in the selection of an anesthetic than does any other type of patient.

For *general* anesthesia ethylene supported by ether is the best combination.

Spinal anesthesia seems to be becoming more and more the operation of choice for grave operations upon the urinary organs. The preliminary administration of

ephedrin minimizes the alarming fall of blood-pressure to such a degree that it is habitually negligible. But spinal anesthesia in order to be successful requires preliminary stupefaction of the emotional centers by morphin and scopolamin and the attendance of a person skilled in distracting the patient's mind so that, if the preliminary narcosis is not entirely successful, the patient's attention may be distracted from his fears during the operation.

Pitkin solution (as prepared by Metz), although it contains a much larger dose of novocain than the 120 Mg. which have heretofore been regarded as the maximum, gives far better anesthesia and at the same time less fall of blood-pressure than any other combination I have employed. The only inconvenience we have found in employing this solution is that it requires that a spinal tap shall be made with the patient in the recumbent position and that the head be immediately lowered, putting the patient in slight Trendelenburg position, so as to prevent the anesthesia rising too high.

Simon D. Ehrlich, who has officiated for me, reinjects a half dose of Pitkin's solution in case the first full dose fails to give anesthesia. He has done this several times for me with impunity.

For perineal, urethra or cystoscopic work caudal anesthesia is preferable.

Spinal anesthesia is truly an artistic piece of work in the sense that it is a manual task, the excellence of which depends upon the temperament as well as the education of the person who attempts it. To argue, therefore, that spinal anesthesia is or is not preferable to general anesthesia is to waste time. Spinal anesthesia will never be generally employed because there are not enough artists to go around. Moreover, it is kinder to many patients and safer for some to make them wholly unconscious of what is going on at the time of operation.

Combined anesthesia, e.g., paravertebral and local for kidney, sacral and regional for bladder operations, is, in the former case, thoroughly unsatisfactory, and in the latter a rather complex way to do a simple thing. The sacral and local combination is adequate for anesthesia for suprapubic operations.

Sacral (caudal) anesthesia, by the injection of 30 c.c. of 2 per cent novocain into the sacral canal is the best anesthesia for perineal, urethral and cystoscopic operations. The parasacral injections do not seem to add to its efficiency. The quantity and concentration named form a far more efficient combination than a lower concentration and a larger quantity.

Local anesthesia depends for its efficacy upon two points:

(*a*) The skin infiltration should be made with 1 per cent solution and should leave a line of wheals.

(*b*) The very generous use of 0.25 per cent solutions beneath the skin.

Regional anesthesia for the perineum is obtained by the caudal method; for the abdomen by gerous nerve-block at the outer edge of the rectus at three points on each side, viz., at the level of the umbilicus just above the pubes and halfway between.

POSTOPERATIVE CARE

The requirements of the patient after operation are much the same as before. It is good practice to administer hypodermoclysis as a routine measure after major operations upon the urinary organs, and even after minor operations upon patients in retention.

THE RETAINED CATHETER

One of the most valuable ways of providing drainage for the bladder, both before and after operation, is by the retained catheter (the indwelling catheter, catheter tied in, catheter *à demeure*).

Before introducing the retained catheter, the whole urethra should be cleansed by a forced injection of acriflavin (1:1,000), and the glans penis scrupulously cleansed with soap and water and alcohol.

The most important preparation for tying a catheter into the urethra is meatotomy. The catheter always sets up a urethritis and unless the meatus is freely open to let the pus out, this accumulates in the urethra and produces an unbearable irritation. Preliminary meatotomy should therefore be regarded as almost a part of the procedure.

The catheter to be tied in should be of generous caliber. A 20 or 22 F. catheter after meatotomy will prove far more comfortable than a 16 F. without meatotomy. The mushroom catheter of Pezzer is used in women, not in men.

The catheter should be made of rubber and flute-tipped. A metal catheter may never be tied in. It will promptly ulcerate the canal. A woven catheter may only be used as an emergency substitute to be replaced within twenty-four hours by a rubber catheter.

The first introduction of the catheter may be facilitated by antecedent injection of 10 per cent novocain. If the cut-off muscle or the bladder neck prevent the passage of the catheter this must be introduced upon an obturator. The obturator is greased with vaseline and the catheter filled with oil. The obturator is then introduced into the catheter until its tip lies about 1 cm. from the tip of the catheter. The outside of the catheter is then well greased and the two instruments introduced as one and moved very slowly, since the obturator has a clumsy curve, until the shaft lies at an angle of 45 degrees with the horizontal. The tip of the catheter is then in the bladder. The obturator is then slowly disengaged by a double motion that holds the catheter in the urethra while the obturator is being withdrawn.

The catheter should lie with its tip about 3 cm. within the bladder so that it cannot be pulled out by subsequent erections.

Fixation.—In the female, the catheter is held in place by tying two silk strings to it as it issues from the vulva and fixing these by adhesive strapping to the lateral gluteal creases behind, and the creases of the groin in front.

Fixation in the male varies according to the instrument used. Fixation of a filiform may be accomplished by tying a silk suture about it as it issues from the meatus, tying the ends of this suture together at a point about 1 cm. distant from the bougie, and then running the ends about the coronary sulcus and tying them above. A catheter is, however, too heavy to be held by this method. It may best be retained by the dressing devised by Sinclair.

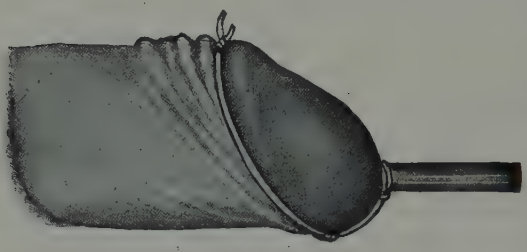

FIG. 121.—FILIFORM BOUGIE TIED IN.

Two pieces of adhesive plaster are cut into small rectangles, of which the long diameter will just surround the catheter, and the short diameter is about 1 cm. From the long edge of this rectangle two strips extend for about 10 cm. and are infolded so that they will not stick. The resultant product resembles a pair of trousers. The rectangles are affixed about the catheter close to the meatus, so that the "trouser legs" extend over the body of the penis at four equal angles. The shaft of the organ is then surrounded without compression by a band of adhesive plaster about 2 cm. in width, the legs of the catheter bands pulled down over this (Fig. 122) and fixed by means of another strip of adhesive plaster. Before this is made adherent, each of the legs is pulled taut. The solidity of the fixation is insured by wrapping a silk string twice about the adhesive plaster on the catheter and tying it tightly.

FIG. 122.—SINCLAIR'S METHOD OF FIXING RETAINED CATHETER.

Position of the Penis.—The penis should lie over the groin; otherwise ulceration at the penoscrotal angle may result.

The scrotum should be supported to prevent epididymitis.

Requisites for Success.—In order that the catheter shall work properly, it is necessary that it should fit loosely but snugly in the urethra, and the directions for preparing the meatus and placing the catheter, as detailed above, should be carefully observed; that its tip should remain at the bladder neck; and that it should be changed every four days; that the

adhesive dressing should consist of strips narrow enough to permit free outflow of pus from the meatus; that antispasmodic decompression be intelligently used; and that morphin be freely administered during the first twenty-four hours in order to accustom the patient to his situation. While the catheter is in place, the bladder should be irrigated at least once a day, and when it is changed the anterior urethra should be thoroughly flushed with permanganate solution.

The catheter always excites a mild urethritis, and sometimes great protestations of pain from the patient; but if the urine drips from it regularly, it is well to quiet the patient for the first twenty-four hours by assurances and narcotics, after which his objections will usually cease; but if the bladder persistently expels the catheter, or if the patient protests too loudly, or if fever results, it cannot be employed.

CHAPTER XLV

OPERATION UPON THE KIDNEY

The only special requirements in the preparation of patients for operations upon the kidney are that the kidneys shall be flushed with water to the point of a diuresis of at least 2,000 c.c. in twenty-four hours, that this administration of water be continued up to within three to six hours of the time of operation, that all retention that can be relieved mechanically, viz., by indwelling catheter, shall have been relieved, and that the renal function, blood-pressure, etc., shall have been given time to stabilize after relief of back pressure, except in emergency.

Ethylene, supported by ether if necessary, is the anesthetic of choice. The twilight sleep—ephedrin—spinal anesthesia combination as described for bladder surgery, can only be employed by the superexpert for difficult kidney operations since these involve a great deal of traction upon the diaphragm, but is suited to many operations upon the kidney and ureter when tuberculosis, senility, etc., render the patient a poor subject for inhalation anesthesia.

It is fully thirty years now since the promise of paravertebral anesthesia was dangled before our eyes, but as Hugh Cabot remarked, in the discussion upon anesthesia for kidney operations before the International Urological Association in 1917 (and which had been preceded by a nephrectomy under paravertebral anesthesia, assisted by Matthew, Mark, Luke and John): "It is all a matter of definition; to some people anesthesia means absence of pain, to others it merely means that the patient remains upon the table."

THE OPERATION

The favored incision of the parietes is an oblique one beginning over the twelfth rib where the edge of the erector spinæ covers it, extending downward and forward following approximately the mid-space between the ribs and the ilium and reaching at least the anterior axillary line. If the kidney is low or the operation is upon the kidney pelvis or ureter, the incision may begin at the tip of the twelfth rib in about the midaxillary line and extend downward and forward well beyond the axilla. If the operation is for tumor, it is customary to carry the incision from the costomuscular angle around almost transversely to the edge of the rectus. Cabot extends this incision through the rectus to the mid-line, and then upward, in order to control the pedicle early if the tumor is large or adherent.

In order to suture so long and curved an incision accurately, it is customary

to mark the skin before cutting it with a few vertical strokes made by the point of the knife.

The surgical anatomy of the loin in reference to this operation concerns the nerves, the pleura and the peritoneum.

The nerves encountered in the loin are three: the twelfth thoracic, with its vessels, the iliohypogastric and the iliolumbar. All three pierce the transversalis aponeurosis just before they reach the midaxillary line. In as much as we learn from dissection and textbook that the twelfth thoracic runs close below the twelfth rib and the other two just above the crest of the ilium, we think of them as widely separated. Such is not the case. Most men standing upright have not two inches between rib and crest. With the loin on the stretch this distance may not be increased more than an inch or two even with the twelfth rib freed from its attachments. Therefore in planning the lumbar incision to avoid these nerves, the difference between going above or below the twelfth thoracic is of no great moment to the surgeon. Most surgeons incise the parietes below the twelfth thoracic and divide its descending branch, thus leaving an extensive anesthesia for the lower flank and outer side of the hip. I prefer to carry the incision above the twelfth thoracic. This nerve runs so oblique a course that if one goes below it and extends the incision well beyond the anterior axillary line, it is not uncommon to cut both the descending branch and the main trunk of the nerve, whereas, going above it I have found actually endangers only the eleventh thoracic at or anterior to the anterior axillary line—hence my preference.

I have opened the peritoneum many times both intentionally and unintentionally in the course of various kidney operations. I do not recollect having witnessed any subsequent infection.

The pleura is quite another matter. I have opened it five times in the course of about 250 kidney operations. On four of these occasions the pleura was opened because I mistook the eleventh for the twelfth rib. There is no excuse for the opening of the pleura inadvertently. The method of avoiding it is described in the ensuing paragraphs.

No attempts will be made to describe the many varieties of kidney incision such as the vertical pararectus incision for kidney tumors which is favored by the general surgeon, or the cramping, vertical paravertebral incision such as has been advised by Kelly, Squier, and others.

The Position of the Patient.—The patient lies upon the side opposite to that upon which the operation is to be performed and upon a "kidney support" which elevates the lower ribs, angulates the lumbar spine and stretches the loin, upon which the operation is to be performed, by an inch or two. It is the custom of some surgeons to strap their patients firmly to the table and then elevate the kidney support in a way that is very straining to the spinal and sacral articulations. In order to minimize backache after operation, I have never lashed my patients to the table. They lie with both arms in front of the chest, the lower arm acting as a support to keep the shoulders from rolling forward. The lower

hip and knee are very acutely flexed in order that this limb shall prevent the pelvis from rolling forward, the upper hip and knee are extended in order to add to the tension on the loin (Fig. 123). Some little practice is required to make the patient balance nicely without strapping.

The Parietal Incision.—Incision is carried from the costomuscular angle with one sweep of the knife downward and forward through the mid-loin or a little above this to about the anterior axillary line. The fibers of the external oblique and the latissimus dorsi are divided and the position of the twelfth rib verified by comparison with an x-ray plate so as to be sure not to overlook it if short. The internal oblique is then carefully divided just below this rib in the axillary region and the twelfth thoracic nerve surrounded by veins and accompanied by its artery[1] is identified on the transversalis aponeurosis about 1 cm. below the tip of the twelfth rib. The veins are very likely to be cut and should be ligated with great care to avoid pinching the nerve. The transversalis is split above the nerve and the division of the muscles slowly carried backward into the loin, following the course of the nerve by touch and sight and dislocating it downward. The sheath of the erector is reached and divided. The muscular attachment below the twelfth rib can often be sufficiently stretched without cutting, though sometimes the quadratus lumborum must be cut. If not, the erector muscle is retracted and the muscular and fibrous tissues that hold the rib down are cut. As these are cut, the rib can be felt to spring upward and one has gained another inch in the vertical diameter of the loin and in freedom of approach to the kidney pelvis and vessels.

As these fibers and ligamentous attachments to the twelfth rib are being cut, the twelfth thoracic artery is likely to be divided in a very inconvenient situation. It is usually easy to clamp but not easy to tie. It has been my custom under these circumstances to leave the clamp on until the end of the operation when ligature will be much more easily performed, or to replace it by a small pad held against the bleeding point with a retractor.

This freeing of the twelfth rib which so increases the access to the kidney pedicle may be omitted if the incision is carried far enough forward anteriorly. The choice between freeing the rib and extending the incision forward will vary in different cases, depending upon the size, position and adhesions of the kidney.

The Pleura.—The diaphragm may be inadvertently torn and the pleura opened in the region of the tip of the twelfth rib. If the eleventh rib is mistaken for the twelfth, the tear will come above the tip of the twelfth rib, but if the rib is identified, the tear can only result from carrying the incision into the muscular tissue of the diaphragm, which lies immediately beneath the fibers of the transversalis aponeurosis. It is an absolute rule that after splitting the aponeurosis, the muscle immediately beneath this, the diaphragm and crus, must be respected. The wound must be opened by traction at first in the downward direction until the fingers have opened the retroperitoneal space.

A sharp whistle from the wound signals the opening of the pleura. As soon

[1] The vessels—veins external—actually lie superficial to the nerve and rather below it.

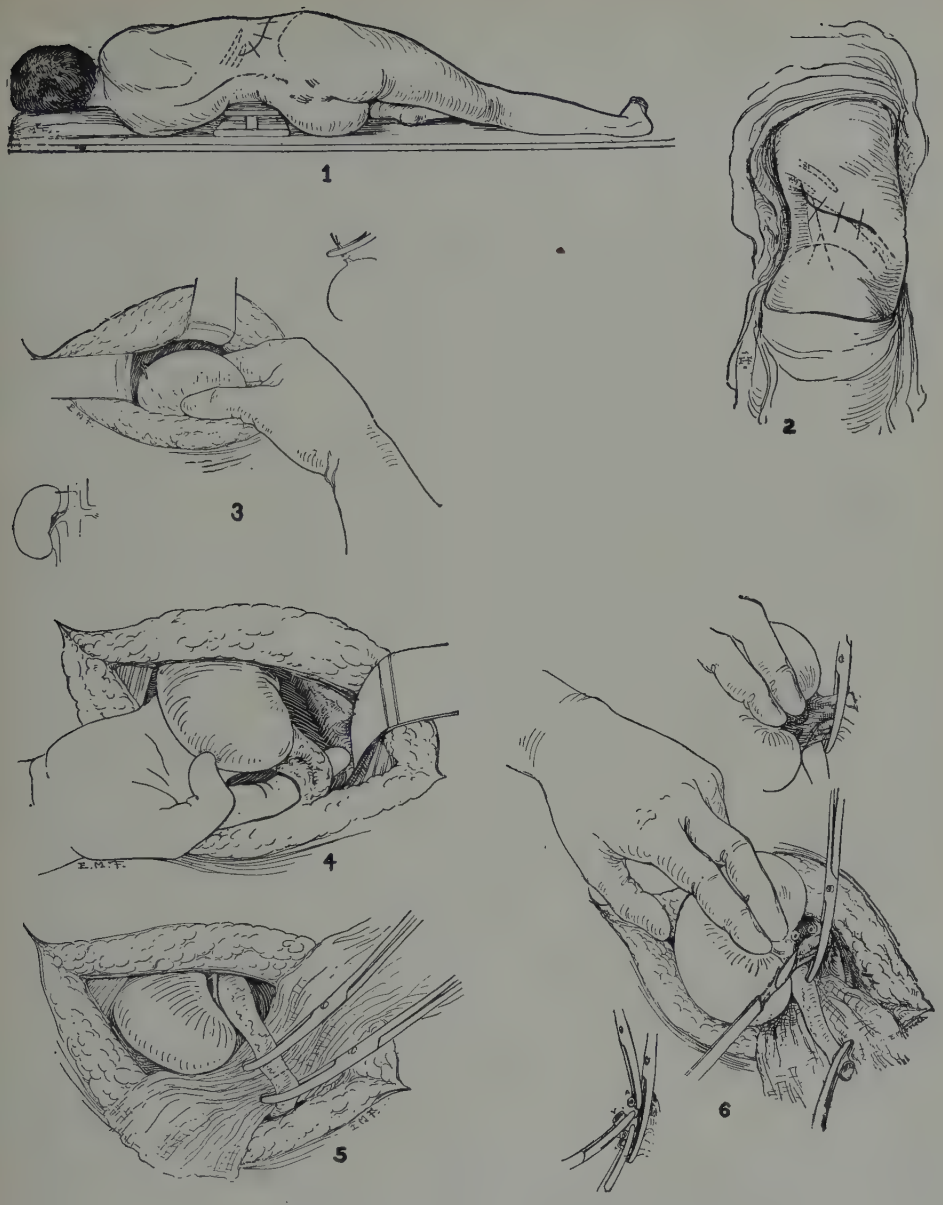

FIG. 123.—DETAILS OF KIDNEY OPERATION.

1, Position for kidney operations. The nether arm and thigh are flexed to prevent the trunk from rolling forward. The location of the incision by cross-scratches is indicated. 2, The same seen from above. The course of the twelfth nerve and its descending branch is indicated. 3, Aberrant artery from the upper pole (inserts show course of the artery, the application of the clamp). 4, The lower pole of the kidney is delivered. The thickened ureter surrounded by adhesions is held up over the finger. 5, Nephrectomy: The thickened ureter has been stripped and is doubly clamped. 6, Nephrectomy: A single clamp controls the pedicle which is cut under direct vision. Inserts show the application of the primary clamp and the application of secondary clamps to the ends of the vessels before the ligature is tied and the primary clamp loosened.

as this is heard, the operator's fingers instinctively press the diaphragm against the rib, thereby stopping the inhalation of air into the pleural cavity. The diaphragm is thus compressed while the wound is being freely opened throughout its length. Then one observes whether there is enough air in the pleura to balloon it out. If this is the case, the fingers are relaxed with each expiration and compressed with each inspiration until the patient has blown enough air out of his pleural cavity to minimize the pressure within it. Then without inspecting too closely to find the actual little rent in the muscle of the diaphragm, one closes the hole by a wide mattress-suture, including the aponeurosis close to the rib on one side and the diaphragm on the other with any fat that may be adherent to it, the object being to plug the wound rather than to close it neatly.

The diaphragm once torn, tears more widely very easily and once a wide tear is established the muscle-fibers are so frail that it is extremely difficult to close. This accident has happened to me but once in a case of lordosis which brought the twelfth rib right against the spine. Before I recognized this, I had made a large opening in the pleura between the eleventh and twelfth ribs. I closed it by fat transplant, but the pleura became infected and the patient died septic. I have known but one other death from injury to the pleura. This occurred to one of my internes whose patient died suffocated on his return to the ward because the positive pressure in the pleura had not been relieved.

Exposure of the Kidney.—After the division of the transversalis muscle one is still separated from the retroperitoneal space by the transversalis fascia. With this cut, the retroperitoneal space is opened and the kidney is sought by inserting the hand up under the ribs with the back of the hand against the psoas and feeling forward for a hard movable body. The kidney should be readily distinguished from the liver or spleen. When it has been identified the fat is cleared away from it until the smooth perinephritic fascia is reached. Cut this and an entirely different type of fat, softer and smoother, protrudes, unless there is perinephritis. With the two index fingers the incision in the perinephritic capsule is widened, the fat mopped away from the posterior surface of the kidney by blunt dissection. Much of this must be done blindly, especially if the kidney is large and adherent above. The expert has here a great advantage over the novice. The freeing of an adherent kidney by clumsy hands may result in damage to the peritoneum, which is unimportant if recognized, to the colon, the duodenum, the pancreas, or the great vessels. All of these dangers lie in front of or internal to the kidney. The anterior surface of the kidney should therefore be freed under direct observation, whereas the posterior surface lends itself to the preliminary loosening of the kidneys, since there are no dangers on this side.

At the upper pole the adherent kidney may involve the adrenal in a dense fibrolipomatous mass which cannot be separated. I have removed the adrenal for this reason a number of times and have noted no immediate or remote evil results, excepting that the torn artery of this organ makes an unpleasant point

of hemorrhage far up under the diaphragm. Patient pressure will control this if the bleeding point cannot be identified.

At each pole of the kidney, even if it is normal, firm fibrous bands may be found leading toward the mid-line. As the contour of the rounded kidney pole is identified, the tissue going from it to the mid-line should be carefully palpated for the pulsation of an aberrant artery or the contour of a vein, lest this be torn inadvertently (Fig. 123,3).

These aberrant vessels greatly restrict the mobility of the kidney and may make it quite impossible to deliver the organ in the loin. If nephrectomy is contemplated there is no objection to doubly clamping and ligating. But if the proposed operation is not a removal of the kidney, aberrant veins may be cut and tied, but aberrant arteries should not be divided until they have first been compressed for several minutes, during which time the kidney dissection is being carried on over other parts of the organ. If the compression results in vascular stasis over a large part of the kidney, the artery may be cut on condition that the surgeon is willing to sacrifice this much kidney tissue. As a matter of fact, this temporary ischemia is not always permanent, but there is no time to determine this point during an operation.

The adherent kidney, especially if destroyed by hydronephrosis or by pyonephrosis, may be hidden amid the retroperitoneal fat and while it may be readily identified by opening the peritoneum, one hesitates to do this in precisely such cases. Unless the kidney is extraordinarily movable or greatly misplaced, it will be found by throwing forward all of the retroperitoneal fat until the greater part of the psoas comes into the field. Then the fascial plains are successively nicked in what one conceives to be the region underlying the costomuscular angle until the kidney is found.

I have twice removed a kidney without seeing a vestige of it, but identifying it only by the ureter which entered a mass of adherent fat from below, the vascular pedicle which ran to it and the chrome yellow suprarenal capsule which capped it, the kidney being recognizable only as a dense retroperitoneal mass with these attachments. Such a kidney when cut open is a mass of sclerotic fat with irregular cavities in it, representing the remains of the pelvis and calices. It seemed convenient to remove one such kidney with the psoas fascia adherent to the back of the mass and the peritoneum adherent to its front.

If such hidden kidneys are not gravely sclerosed, but are difficult to find only because they have previously been operated upon, one may expect to find the lower pole of the kidney adherent to the parietes in the costovertebral angle and boldly cutting through scar to this point, guided in one's judgment by the preliminary pyelogram, the kidney parenchyma will be cut in the midst of scar. Carry the incision backward over the dorsal surface of the kidney and a point will soon be reached where the finger can be inserted under the fibrous capsule and swept around the upper pole of the relatively normal kidney parenchyma. The lower pole will be disengaged with more difficulty since it has been involved

in the scar made by drainage, but the orientation obtained permits a subcapsular nephrectomy.

When the surgeon fails to find the kidney at the costovertebral angle, it may be located by following up the ureter to the kidney pelvis.

Identification of the Ureter.—The ureter runs from the kidney pelvis directly downward and immediately internal to the lower pole of the kidney to which it is often adherent. In the midst of a massive perinephritis it may be difficult to find the ureter. The following points will help in its identification. Between the vena cava and the lower pole of the kidney lie two parallel structures somewhat similar in dimensions, the spermatic, or ovarian, vein and the ureter. The ureter is external to the vein. The identification of either locates the other. If neither can be found at the level of the lower pole of the kidney, they may be sought on the posterior surface of the peritoneum lower down where the vein is much more readily identified than the ureter which lies external to it. The two cross, with the ureter behind the vein, at about the level of the fourth lumbar vertebra (Fig. 123_4).

Drainage of the Loin Wounds.—Uninfected loin wounds should be closed without drainage after the wound has been filled with 1:10,000 acriflavin or saline solution in order to replace the air which would otherwise be enclosed in the wound as the muscles are sutured.

Wounds of whose asepsis one cannot be sure are drained by rubber tissue or a drain cigarette.

Wounds that have been grossly infected or that lead to a kidney or kidney pelvis or ureter that has been opened, whether it has been sutured or not, must be drained by tube since the volume of urine that may be discharged is likely to be too great for any other form of drainage.

Owing to the grave suppuration that has sometimes followed the removal of a pyonephrotic kidney, if the kidney was burst during its removal, the practice became quite general of leaving the loin wound unsutured after such an operation. It was asserted that such unsutured wounds would heal without hernia. They do not.

If the wound has been considerably infected, the muscles should be closed up to the posterior axillary line, drainage with several tubes provided behind this point and the skin sutured only in the forward half of the incision, leaving the sinus through the skin much wider than through the muscles. This funnel-shaped opening will effectively prevent any undermining and will protect the wound from hernia throughout the axillary region. Hernia does not occur in the back.

Suture of the Parietes.—The transversalis muscle should be sutured in a separate layer with chromic catgut, space being left for adequate drainage posteriorly.

The muscle is quite frail and may well tear unless the loin tension is reduced by lowering the "kidney support" and by flexing the hip and knee of the patient. Special care should then be taken to unite the transversalis fascia below the

muscle and the intermuscular fascia above it in the same suture that closes the muscle.

In the anterior portion of the wound, care must be taken not to pierce the nerves or accompanying vessels that run on the transversalis muscle along the edge of the incision. When closing the aponeurosis the nerve along the lower edge of the incision must be avoided and allowance made for it to pierce the aponeurosis at a convenient point.

POSTOPERATIVE TREATMENT

If the pleura has been opened, the patient is returned to his bed, where he lies upon his sound side, while if a clamp has been left on the renal pedicle, the nurse is instructed to protect this from being wrenched off during the patient's recovery from anesthetic.

Most clinics practice the excellent routine of 500 c.c. of hypodermoclysis while the patient is recovering from his anesthetic and Murphy drip is employed until the patient can begin to take water by mouth. When this moment arrives, really hot water will be retained much better than any other fluid and if the operation has been a grave one, the convalescence will be greatly expedited by restricting the patient to hot water exclusively until all danger of abdominal distention has passed, which usually coincides with the time of the first bowel movement.

The patient should take from 3,000 to 4,000 c.c. of fluids a day until the kidney function is well established; then this amount may be rapidly dropped to normal.

Drainage tubes that are delivering urine will be left in place until urine no longer flows through them. No irrigation of the loin wound will be attempted during the first week but thereafter if the tube is still in place, a very gentle daily injection of 1:4,000 permanganate hastens healing. In one instance the tube was so accurately placed that by pushing upon it the interne could open the kidney pelvis and get a gush of urine. It was necessary to persuade him of this fact before he would desist and permit the wound to heal.

I have not convinced myself that either decubitus or walking about expedite or delay the closure of a urinary fistula in the loin. In as much as the firm suture of the transversalis muscle insures against hernia, most patients may be permitted out of bed as soon after the eighth day as their condition warrants.

In other respects postoperative treatment is quite that of any abdominal case excepting in so far as nephrectomy or nephrotomy have special complications—which are dealt with under these heads.

CHAPTER XLVI

OPERATIONS UPON THE KIDNEY

DECAPSULATION

Decapsulation of the kidney is a part of many operative procedures. Decapsulation is done by nicking the fibrous capsule of the kidney upon its convex border, inserting a grooved director upward between the capsule and the parenchyma and incising the capsule along this until the upper pole of the kidney has been turned. The same procedure is then followed around the lower pole and the split fibrous capsule is then peeled down on the anterior and posterior surfaces of the kidney.

Unless the capsule is slit on the groove of the director, the parenchyma will be rather deeply nicked in spots and unnecessary hemorrhage will result. The immediate profuse hemorrhage following decapsulation should be disregarded. It cannot be stopped artificially. It will promptly cease of its own accord as the torn capillaries contract and become plugged by clot.

NEPHROPEXY AND RELIEF OF HYDRONEPHROSIS

After exposure of the kidney the perirenal fat is wiped away and removed from within the perirenal fascial capsule, leaving a bare kidney to lie in apposition with the fascia in front and behind. Decapsulation of the kidney is then performed.

If the operation is performed for the purpose of relieving ureteral obstruction, the pelvis and the upper portion of the ureter are also stripped of fat sufficiently to permit the identification of the point of obstruction and its relief by freeing bands of adhesions or by a plastic operation upon the pelvis or the ureter.

The obstructions occasioning hydronephrosis are found either in the ureter or at the junction of the ureter and kidney pelvis.

Ureteral obstruction by external adhesions is relieved by dissection of these. One need not fear exposing the greater part of the ureter if care is taken to leave it adherent to the peritoneum throughout those portions of its course where it manifestly runs straight and needs no liberation. After all kinks have been relieved, it is wise to open the ureter or the kidney pelvis at a convenient point and test the caliber of the duct by running a 14 F. bulb down and into the bladder. This bulb may find points of anatomical narrowing about 2 cm. below the kidney pelvis, at the brim of the bony pelvis and as it enters the bladder.

These are not proven ureter strictures even though the bulb cracks them, so long as they permit it to pass.

Strictures in the upper ureter too tight to permit the passage of the bulb and too cicatrized to dilate should be slit longitudinally with as short a cut as possible and the ureter resected as described in the next chapter.

Obstruction to the ureter by an aberrant vein at the lower pole of the kidney should be met by division of this vein. Obstruction by an artery at this point may be relieved by division of this artery or by division of the ureter and reimplantation of this into the kidney pelvis in case temporary compression of the artery shows that it feeds a large proportion of the kidney parenchyma. This operation is described in the next chapter as are the plastic operations for abnormal implantation of the ureter into the kidney pelvis.

After these procedures, nephropexy is performed. Many methods of doing this operation have been advised, not one of which seems to fit all cases. Nephropexy aspires to fix the kidney in a position in which its pelvis will drain without obstruction. This is accomplished most readily by drawing the lower pole outward. The actual elevation given the kidney is unimportant so long as the ureteral obstructions have been relieved.

The kidney fascial capsule has been emptied of its fat. The kidney is to be retained in apposition with the posterolateral abdominal wall in as high position as possible by suture or by pressure from below. It will sometimes be found possible to make a sling for the kidney by suturing the anterior and posterior layers of the fascial capsule together just below the hilum in such a way as to support the lower part of the kidney without compressing or kinking the ureter and without permitting the kidney to turn over during the patient's violent diaphragmatic agitation after operation. A safer way to accomplish the same result is by suturing a large and long cigarette drain in a loop around the lower pole of the kidney and removing this during the second week. This has the inconvenience of delaying the healing of the wound and the procedure I have usually followed is to support the kidney by suture.

The capsule which has been stripped from the front and back portions of the kidney is once again slit at right angles, leaving four triangular tabs representing the four quadrants of the kidney. The lower two of these are caught in a clamp and transfixed with a chromic gut ligature which is tied about the stump of the triangular flap of fibrous capsule and retied over its apex turned backward. The suture is then fixed to the abdominal wall or to the lumbar muscles in the region of the costovertebral angle at the most convenient point. It is unsafe to put sutures in the diaphragm lest they perforate the pleura. The sutures should be so placed as to tilt the lower pole of the kidney slightly outward and to fix it so that with the kidney support removed, even the deep respiration of general anesthesia does not bring down more than half of the kidney into the loin. Care is taken to see that the ureter is not kinked and that the kidney has no tendency to turn over (Plate V, Fig. 3).

Kidneys so fixed if operated upon years later will be found firmly adherent.

The causes of the failure of nephropexy are three: the operation may have been performed for the relief of a symptom that was not relievable by nephropexy, or the kidney has been left in a position where it is traumatized by the patient's ordinary activity, or the ureteral obstruction has not been removed.

OPERATIONS FOR THE REMOVAL OF STONE

Stones in the kidney pelvis or calices are preferably attacked by an incision of the pelvis, or pyelolithotomy, which may be extended downward on the concave border of the kidney to open the lower calix widely, Marion's pyelolithotomy, or supplemented by incisions in the convexity of the parenchyma.

The operation may occasionally be performed without dislocating the kidney from its bed and this is the preferable procedure for such cases. But if the least difficulty is encountered, the kidney should be mobilized and brought up into the wound. The various operations will be described as though performed in this latter manner.

Pyelotomy.—The kidney is lifted up into the abdominal wound and steadied there by the surgeon's left hand while with his right he strips the posterior surface of the kidney pelvis entirely free from fat unless this fat is so adherent that it has to be incised. If the kidney pedicle is not long and one is cramped for room, one should not hesitate to enlarge the parietal wound forward and to steady the kidney by a pad of gauze which runs in a loop under the upper pole from behind forward, around the vessels in front and then under the lower pole to its posterior surface. It is possible with this loop to pull the kidney off its vessels, though I have never seen this done. It is also very easy to make the pressure so taut that the arteries are almost wholly compressed and bleeding is minimized.

The pelvis is then opened by an incision large enough to admit the index finger and running from the center of the hilum orifice toward the ureter. In making this incision two precautions are to be observed: the retropyelitic vessels must be identified and drawn up under the edge of the hilum so that they may not be cut and cause annnoying hemorrhage, and the incision must be carried actually into the kidney pelvis without going beyond it through its anterior wall. To do this neatly on an undistended pelvis requires as much experience as it does to open the undistended tunica vaginalis. Adherent fat may so muffle the pelvis as to make it very difficult to discern its cavity and if the pelvis is normal its mucous membrane may be pushed away from the muscular coats by the point of the knife instead of being incised.

With the pelvis open, if a stone presents, this is seized with a curved clamp or gall-duct forceps and removed. If the stone is too large to come through the incision, the size of this may be trebled by deliberately carrying it down through the lower pole of the kidney on its posterior surface. This divides the retropyelitic artery and causes hemorrhage from the parenchyma, which may be controlled by the gauze loop above referred to, or if this proves inade-

quate, by temporary gentle compression of the vascular pedicle of the kidney either with the fingers or with an intestinal clamp. I prefer the gauze loop.

Pyelonephrotomy.—If the pyelonephrotomy incision is not large enough to remove the stone, this can be broken up and removed piecemeal, though for such large stones nephrectomy is often to be preferred.

The calices are now searched by counterpressure between the thumb and forefinger on the outside of the kidney and the tip of the little finger placed successively in each of the larger calices. Stones visible in the x-ray picture are first sought for and calices that were manifestly normal and not distended in the pyelogram are not investigated. Small fragments thus discovered in a calix are very difficult to extract entirely through the pelvic incision. If grasped by a forceps, this crumbles them and leaves a dust to form a nucleus for new stones. It is much easier to press the stone outward toward the convex border of the kidney with the tip of the little finger in the calix, but down upon the stone through the convex border and after having pushed the stone out of the parenchyma, continue pressure with the finger in the calix until the little incision is closed by suture.

If the stones are more than two or three in number, small fragments are likely to have been overlooked, chipped off or crumbled from the larger pieces; or stone in the form of sand or grit perhaps held together in masses of fibrin may form a very difficult problem which is best solved by nephrectomy. If this is contra-indicated by the disease or absence of the other kidney, the best one can do is to flush the pelvis and calices thoroughly with saline solution in order to wash out as much grit as possible.

It is especially to be noted that the many-branched or so-called stag-horn calculus, filling as it does the undilated calices, can scarcely be removed without the loss of one or two fragments which it is almost impossible to discover by palpation. In order to detect such fragments the Mayos perform a fluoroscopy upon the operating table. The tediousness of this operation and the difficulty in delivering the kidney far enough out of the loin to permit of fluoroscopy are almost insurmountable obstacles to its general adaptation. Quinby slips a small x-ray film surrounded by a sterile envelope under the kidney, takes a brief exposure of this and awaits its development before closing the kidney. This procedure is no more time-consuming than the fluoroscopy and would be an excellent substitute were one certain that any fragments shown by the first plate taken could then be removed with the assurance that the next plate would show no more stone. Unfortunately this is not the case. One exposes the first plate and stone fragments are seen upon it. One removes these to one's satisfaction, exposes a second plate, sews up the loin and the second plate shows fragments that have twice been overlooked. In short, these devices interfere with efficient surgery and are themselves not wholly efficient. Seth Hirsch has endeavored to solve the problem by coating a film with a sensitive chemical which will immediately exhibit the fragments remaining in the kidney and from which these shadows can be wiped out by a brief reëxposure to the x-ray, the blank

film again placed behind the kidney and again exposed to show what fragments the second exploration has overlooked. This technic is not yet practically developed.

Fortunately most stones thus overlooked will remain fixed as they grow and will therefore be silent for many years, during which the patient may fancy himself well, though the urine will continue to contain pus. Moreover, the kidney parenchyma may have been so destroyed by the operation that it excretes a very low concentration of solids and the growth of these persistent fragments may therefore be very slow, but if the kidney is as badly off as this, one would probably have done better to remove it in the first place. Indeed, for all cases of multiple small stone, scattered throughout the kidney, nephrectomy is the preferable operation.

Under no circumstances may the kidney be slit from end to end, even though this incision be carried in Brödel's line—the relatively avascular sagittal line about 5 mm. posterior to the convex border of the kidney. This so-called anatomical division of the kidney always divides vessels the bleeding from which may prove fatal and the sutures to control which will destroy so large a proportion of the kidney parenchyma that, even if the organ is saved, it has little physiological value. Multiple small incisions through thinned spots, over dilated calices, are always to be preferred to the complete bisection of the kidney. Needling is ridiculous.

Drainage.—If only the kidney pelvis has been opened, ureteral drainage is assured by passing a bulb down into the bladder and the incision in the pelvis is then closed by through and through interrupted catgut sutures. If the incision has been extended into the hilum, these sutures will not close the gap. In fact, they rarely do this. Some urinary leakage must be provided for in all cases by tube drainage of the loin wound down to the kidney pelvis. I fancy that suture of a layer of fat over the wound in the pelvis helps to close this. But I know that the ultimate closure depends solely upon good drainage of the kidney pelvis down the ureter. Fixation of the kidney in a position to assure this will insure rapid healing of the urinary fistula in the loin. Indeed, occasionally a pyelotomy wound that has not been sutured at all will never leak a perceptible amount of urine through the loin if the ureteral drainage is perfect. The indwelling ureteral catheter simply plugs the ureter and makes drainage worse instead of better, if applied immediately after operation.

If nephrotomy has been done, it is customary to leave a tube in the nephrotomy wound, suturing the parenchyma closely about this and leading it to the most dependent portion of the kidney pelvis. No irrigation of the kidney pelvis should be given through this tube until a week has gone by, then with gentle pressure and small quantities of solution, the pelvis may be irrigated daily. Such a tube may be removed at any time after the fourth day if the kidney parenchyma is sclerotic and thinned, but if the tube has been placed through a wide area of relatively normal kidney tissue, it should not be disturbed until the end of the second week for fear of parenchymatous hemor-

rhage. Indeed, this danger makes one disinclined to leave a tube in the normal kidney parenchyma.

Suture of the Kidney Parenchyma.—The pelvis is sutured as stated above with through and through interrupted stitches of plain catgut. If the parenchyma is sclerosed it is closed by mattress-sutures enclosing rather wide areas of kidney tissue to control arterial bleeding and inserted on a blunt aneurysm needle or with a needle of wide curve used eye-end forward so as not to pierce a renal artery.

All important hemorrhage can be readily controlled by one or two deep sutures properly placed. Parenchymatous oozing should be disregarded through the operation excepting in so far as it is a nuisance in the operating field. This parenchymatous bleeding may be temporarily controlled by the compression of the kidney pedicle, but, when this is relaxed, it will again pour out for a minute or two and will then cease spontaneously however alarming it may have appeared at first. Sutures tend to cut through the kidney parenchyma. They may be made to hold by tying them over pieces of fat obtained from about the kidney.

NEPHROSTOMY

Permanent nephrostomy as a preliminary to cystectomy or for the relief of bladder tuberculosis has been entirely discarded in favor of ureterostomy. Temporary nephrostomy is done under two conditions: For stone, notably for calculous anuria, and for pyonephrosis.

The ideal operation for calculous anuria is bilateral simultaneous pyelotomy without waste of time to search for stone, but with the object of immediately saving the patient's life by drainage of both kidney pelves.

If, during the course of such an operation, one of the kidneys is found considerably dilated, it is much more convenient to drain through a thinned-out portion of the parenchyma over a dilated calix. The operation does not materially differ from that of nephrotomy above described.

But nephrostomy for pyonephrosis is another matter. The object of this operation is to drain the kidney with as little disturbance of the surrounding tissues as possible and with the hope that if the pyonephrosis is acute, it will subside spontaneously and ureter drainage will be satisfactorily resumed; or if it is chronic that the operation of nephrostomy shall not disturb the perinephritic tissue sufficiently to interfere with the comfort of the subsequent nephrectomy.

The operation is often performed under local anesthesia. The incision is over the most prominent portion of the tumor. If this is forward of the axillary line, one must foresee the necessity for traversing the peritoneal cavity. This may be done by opening the parietal layer of the peritoneum, in front of the tip of the tenth rib, carefully making a small hole in the posterior layer where it covers the pyonephrotic kidney and by a blunt dissection lifting up a cone of this posterior peritoneum until it can be sutured to the anterior layer, thus absolutely closing the peritoneal cavity before the abscess is punctured. If the time is available, it is preferable to pack this wound and postpone the opening of the abscess for twenty-four hours.

If the operation is performed in the loin, the caked perinephritic tissue is divided through a small oblique incision until the kidney is reached. The kidney is incised, the finger introduced to explore it as far as possible and a tube tied in.

The tube remains in place at least three weeks. The kidney cavity is irrigated daily after the first week. A pyelogram is taken through the loin wound and if it is believed that the ureter will drain the kidney, the tube is removed with this hope. Otherwise nephrectomy is performed, the kidney being discovered by a dissection behind the line of nephrostomy incision.

NEPHRECTOMY

Should adhesions interfere with mobilization of the kidney, as they sometimes do even to the point of obscuring its position and even infiltrating its substance, the surgeon need not be dismayed. Any kidney may be removed, however scarred, distended or diseased. The kidney is identified as already described. If the ureter is used as a guide to the kidney, the only danger to be borne in mind is that the dilated ureter may be adherent to the vena cava; this is true of the left side as well as the right. If the ureter is dilated and the adhesions very dense, open it and dissect it free with a finger in its lumen. As the kidney pelvis is reached dissection is carried up the posterior surface of this until the parenchyma is recognized; then the posterior surface of the kidney is freed and an effort made to carry the dissection over to the anterior surface. If one becomes lost in adhesions at this point the peritoneum should be freely opened, with due respect for infection if the waterways have been opened, the colon separated from the kidney and the peritoneum closed. Even in the densest adhesions the larger renal arteries can now be identified by palpation, clamped and cut, and the kidney removed.

The above laborious technic is required only for the most adherent kidney. Usually the organ can be identified readily enough. Allowance need only be made for careful palpation to identify aberrant arteries at the upper and lower poles before they are cut, and for adhesion of the inner border of the kidney to the colon, the duodenum, on the right side, and the cava.

Subcapsular Nephrectomy.—If the fibrous capsule is torn, it may be stripped off down to the hilum. Then it is reflected, the kidney delivered, and the reflected capsule carefully divided under direct observation at a point about 1 cm. from the posterior edge of the hilum. The renal vessels are adherent in a mass of sclerotic fat immediately beneath the reflected capsule (Fig. 124). The ureter is then identified, divided between clamps, cauterized with pure phenol, and the pelvis dissected free from the renal vessels. The rent in the fibrous capsule is then enlarged by blunt dissection around the front of the pedicle exposing the vessels.

Ligature and Section of the Pedicle.—No attempt should be made to clamp the pedicle until the ureter and kidney pelvis have been freed from it.

Stout catgut is an adequate ligature material. If the pedicle is surrounded by uninflamed fat this should be stripped off before applying the ligature; otherwise the vessels may slip out of its grasp. Adherent fat cannot be wholly stripped off.

Many surgeons have the habit of fussing over the pedicle, applying two clamps, tying between them, etc. This is scarcely worth while. A ligature applied while the clamp is on the pedicle is likely to be found quite loose when the clamp comes off. If the pedicle is unmanageable, tying the individual vessels is not an easy task. Worst of all, the relatively complicated methods of handling the pedicle bespeak and encourage a wrong frame of mind. Whatever the care taken to prevent it, a clamp may break, a ligature may slip. The surgeon should be prepared for this and realize that the slipping of the ligature from the pedicle is an accident of no great moment. The resulting hemorrhage is furious, to be sure, but immediately controllable unless the surgeon is too frightened to act coolly. One immediately plunges a pad of gauze into the depth of the wound over the bleeding point. *Next look at the clock.* Observe the time, then mop out clots, insert retractors, enlarge the parietal wound if necessary. *Then wait five minutes.* Then remove the pressure; the bleeding will be so slight that the bleeding points can be readily recognized and cleanly clamped. I learned this trick from Marion. I have had to employ it thrice. It worked. Marion has such confidence in it and is so fully aware of its importance that he deliberately demonstrates it to his students every year.

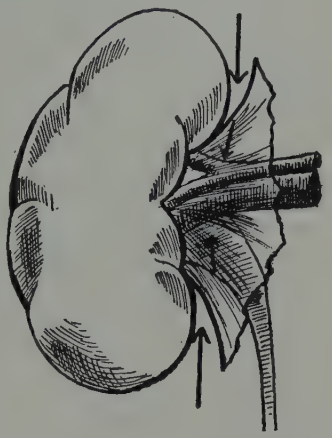

Fig. 124.—Showing How the True Pedicle Is Obscured by the Fibrous Capsule in Subcapsular Nephrectomy. (After Albarran)

If, after all, the pedicle seems so dense that one is afraid to attempt any kind of ligature there is no objection, except the patient's discomfort, to leaving the clamp in place. It should be loosened on the morning of the third day and removed some hours later.

The clamp to be used for the renal pedicle should be selected with great care. In many instances, it is true, a Kocher or Carmalt clamp will suffice as a pedicle clamp and it is often possible to separate the pedicle into two or more bundles of vessels or even to clamp and ligate each of the vessels separately. But when the pedicle is short and densely matted together or the diseased kidney so large that the pedicle can scarcely be seen, it is necessary to clamp the pedicle rather blindly and remove the kidney, trusting to the clamp. For such a purpose no instrument is better than the stout broad-ligament clamp, the blade of which is set at an angle of about 45 degrees with the handle. I rather prefer to place the clamp with the point downward, for the main artery is situated toward the

upper portion of the kidney pedicle and with the clamp pointed downward there is no possibility of its escaping compression.

The clamp is placed at least 1 cm. from the kidney parenchyma if this is possible, and if placed blindly the fingers of the opposite hand must be used to push back the surrounding tissues from its point so as to be sure that it does not grasp the vena cava below.

The kidney pedicle is then divided between the clamp and the kidney parenchyma as close to the latter as possible. Care is taken not to continue the incision backward into the kidney pelvis. As each vessel in turn is cut, one takes advantage of the released tension upon the kidney to get a better and better view of what one is doing.

As soon as the last vessel has been cut, the tips of the arteries are grasped in Kocher forceps (Fig. 123,6).

The ligature of the pedicle is habitually done by transfixing its lower part and ligaturing this tightly, then throwing the ligature about the upper end so that it encloses the whole of the pedicle and tightening the ligature progressively as the broad ligament clamp is removed. Heavy plain catgut should be used.

When the case is an extremely difficult one and the dissection unsatisfactory so that one is left with a very wide pedicle, it sometimes seems safer to cut away the kidney in such a way as to leave a thick nubbin of parenchyma distal to the clamp so that this may act as a sort of knob to prevent the ligature from slipping off the pedicle. If this cannot be done, the clamp is left on, to be loosened and removed on the third day.

Drainage.—A cigarette drain should usually be left in for two days. If it is to be omitted the wound should be filled with salt solution to expel the air which will otherwise work its way into the scrotum, making it emphysematous. Infected wounds are better drained by tube for at least a week. If the wound is badly infected the only way to assure good healing is to insert several tubes, so that the capillary drainage between the tubes will relieve all tendency to infiltration.

No irrigation of the loin should be attempted in the first week after operation for fear of spreading infection in the perinephritic fat.

Nephrectomy for Tuberculosis

The special surgical requirements of the tuberculous kidney are two:

The perirenal fat is usually invaded by the inflammation. Hence the dissection should be carried through it in such a way as to leave as much of this fat adherent to the kidney as practicable.

The tuberculous ureter has been a source of great surgical difficulty. The fact that it is obviously invaded by the disease has persuaded surgeons to endeavor to remove as much of the ureter as possible. This assumption has led to prolonging the operation and extending the wound in the vain hope of eradicating the local manifestations of the disease. Actually, the tuberculous ureter

should be treated in one of two ways. If its gross dilatation and thickening is inconsiderable, it should be tied off with plain catgut, its end cauterized with pure carbolic acid and dropped into the wound. But the dilated ureter is likely to permit postoperative reflux of urine from the bladder. The greatly thickened ureter is probably the seat of mixed infection and will not heal. To drop such ureters back into the wound without providing special drainage for them runs the risk of starting in the depth of the wound a mixed infection which will result in disastrous prolonged tuberculous wound suppuration. Therefore such ureters should be freed below the point of section sufficiently to permit the rubber sleeve of a cigarette drain to be slipped over them and attached with a plain catgut suture. This rubber drain will be kept in place for two weeks to lead directly out of the wound any suppuration which may arise about the tip of the ureter.

In closing the wound, no other drain than this is required, unless the urinary channels have been opened during the operation. Ordinarily, therefore, the loin wound is to be closed without drainage after removal of a tuberculous kidney. This is especially important since it avoids postoperative mixed infection from the lumbar skin. In order to fill dead spaces the wound is almost completely closed and is then filled with salt solution just as the last suture is tightened and tied.

The special complications following nephrectomy for tuberculosis are two: ureteral reflux and tuberculosis of the wound.

Ureteral reflux is very rare and may occur after nephrectomy for any form of chronic kidney suppuration. Two of the three times that this accident has occurred in my practice, however, have been in cases of tuberculosis. The reflux may not appear until a week or so after the operation. It comes on suddenly and for a while the greater part of the urine is excreted through the loin wound. The patient may be reassured, however. The reflux will continue for several weeks—perhaps for two or three months. It will then cease spontaneously.

Tuberculous infection of the wound is a much graver complication. To prevent it we close the wound without drainage when possible and drain to the ureter stump as described above when necessary. The object sought is the prevention of mixed infection. Doubtless some tuberculous perinephritic tissue is left every time a tuberculous kidney is removed. But if mixed infection can be prevented from reaching this, no loin tuberculosis will result.

But if the wound does badly, it will be found within two weeks that suppurating sinuses have extended beneath the superficial fascia the whole length of the wound and perhaps beneath the muscle as well. As soon as there is any evidence of undermining of the skin, the whole length of the wound should be opened down to the muscle layer and Carrel or mercurochrome dressings applied. If these fail to control the suppuration, the wound will lie open a year or more and the chronic suppuration may end fatally. But if the wound heals, there will come a time when lipiodol injection will show that the sinus is a relatively straight wound and at this time, from six to twelve months after the operation, healing may be greatly expedited by anesthetizing the patient and excising as

much as possible of the tuberculous tissue, leaving the wound widely open so as to encourage healing from within.

Nephrectomy for Neoplasm

The cardinal principles of nephrectomy for neoplasm are that the pedicle be tied early and the kidney removed with its perirenal fat in one piece. The special difficulties to be surmounted relate to the size of the mass and to the invasion of surrounding organs.

Hence a much larger exposure is required than for other types of nephrectomy. This is best obtained by the Cabot transverse incision or by a pararectus incision, or by a combination of the two. The simple transverse cut to the edge of the rectus usually suffices. For the largest tumors, such as the Wilms tumors of young children, a vertical incision from pubes to ribs at the outer edge of the rectus is preferable.

It is immaterial whether the perineum is opened or not, but if it is, the incision should be made as far away from the mid-line as possible and the retroperitoneal space is again reëntered by a vertical incision to the outer side of the colon. The dissection of the mass is carried primarily over its anterior surface, contrary to the usual rule, in order to distinguish early the presence of irremovable adhesions to a surrounded viscera or to the diaphragm and in order to clamp the pedicle before lifting the tumor from its bed. If this can be done, the danger of venous metastases by bits of tumor tissue is greatly lessened and one can early recognize the existence of masses of tumor invading the renal vein and cava. If such are found, an attempt may be made to remove them by compressing the cava above and below, excising the renal vein at its origin and closing the wound with a vaseline suture. Only an expert surgeon may attempt such an operation.

When the retroperitoneal space is entered the tumor mass is often found covered with distended veins so numerous and so readily torn as to present a seeming barrier to further progress. But by carefully avoiding even opening the perirenal fascia within which the veins lie this obstacle is surmounted.

Adhesion of the tumor to the surrounding viscera may at any stage of the nephrectomy show the futility of attempting a cure, but even so it is wise to try to complete the nephrectomy, or at least to tie the renal vessels in order to prevent subsequent hemorrhage from the kidney.

After the kidney has been removed, the loin should be searched for enlarged glands and, if any are found, they should be removed by dissection between the aorta and the cava.

Nephro-Ureterectomy

Nephro-ureterectomy is called for under two conditions: Dilatation due to tight stricture at the lower end of the ureter and epithelial tumor of the kidney pelvis or ureter.

The two indications are not quite the same. The dilated ureter can often be removed down to the point of constriction by extending the loin wound forward to the edge of the rectus with a downward curve at its anterior end. But if the obstruction is near the bladder wall, it will save a great deal of time in sewing up the wound if the lower dissection is done through an oblique almost transverse incision over the appendical region where, through a muscle-splitting incision, the course of the ureter may be followed from the loin wound down into the pelvis and it may be tied just above the uterine vessels or the seminal vesicles. If the case is one of tumor, it may then be watched closely for several years and if tumor recurs in the stump of the ureter, this may be removed by a technic similar to that employed for diverticulum. It is customary to advise that this second operation be done immediately or indeed that the whole ureter with its cuff of bladder mucosa be removed with the kidney. The mortality of such a procedure would be relatively high and it is not often carried out.

Nephrectomy for Malformed and Misplaced Kidney

Operation upon misplaced and malformed kidneys is attempted so rarely that the surgeon may be unduly alarmed at the unfamiliarity of the operative scene. As a matter of fact, the kidney, wherever found and however deformed, may always be removed by the patient surgeon and with no great mortality if he is protected by adequate renal function tests proving the sufficiency of the remaining kidney and if he takes pains to identify the ureter, to suspect its duplication and to palpate for arteries in every bunch of adhesions.[1]

Heminephrectomy

The removal of half of a kidney or of half of a horseshoe kidney likewise presents no great difficulty. The horseshoe kidney must be identified by the fact that the ureter runs in front of the lower pole of the kidney instead of internal to it. The unfamiliar surgeon will retain an almost invincible conviction that the lower pole of the kidney is directed downward and not inward, but the experienced operator finding a low kidney with short or multiple pedicle and a large inaccessible lower pole will immediately look for the ureter attached to the peritoneum in front of this and upon identifying the ureter he will understand the situation.

The portion of the kidney to be resected, whether it be one of the poles or the isthmus of the horseshoe kidney, should first be well exposed and then clamped loosely, or the ureteral vessels compressed. Resection is then performed and the cut edges brought together by mattress-sutures much as is done after an ordinary nephrotomy.

These sutures, however, take a wide grasp in the kidney parenchyma and are

[1] But pyelolithotomy upon such kidneys is extremely difficult.

very likely to cut through. Such cutting may be prevented by inserting a lump of fat or a little bundle of catgut beneath each suture loop.

The resection will of course be performed with due reference to the circulation to and the urinary drainage from the remaining kidney.

Resection of the Cystic Kidney

Kidneys occupied by solitary cysts need not be sacrificed. The cyst wall may be readily dissected from the kidney parenchyma and the resulting raw surface sutured with mattress-sutures inclosing buffers of fat.

Operation upon the Polycystic Kidney

Rovsing's operation, which consists in the removal of the outer half of as many cysts as possible, will greatly reduce the size of the abdominal tumor. But in as much as this operation cannot stay the pathological process within the kidneys themselves, it is usually performed only when a polycystic kidney is discovered where a tumor of the kidney had been looked for.

I have removed three polycystic kidneys, two for suppuration and one for hemorrhage. In as much as the size of the tumor is readily reduced by puncturing cysts, the operation presented no grave difficulties and the three patients chanced to survive.

RESECTION OF THE NERVES OF THE KIDNEY[2]

The kidney is exposed and delivered into the wound. All the fat around the kidney and ureter is removed, care being taken not to injure the vessels of the ureter. Under a strong light (Papin uses a head light) and with the aid of a magnifying glass the vascular pedicle is inspected both in front and behind and all fat carefully freed from the vessels and removed, carrying with it the nerves which accompany the vessels. These nerves can be identified as thin white threads, more resistant than the lymphatics. After the removal of the fat the vessels are carefully inspected and all nerve filaments picked up with toothless thumb forceps and grooved director and divided. Considerable skill and care are required to avoid injury to the renal vein, for many of the filaments run right alongside of the vessels.

This operation has attained some popularity in France and elsewhere in Europe for the relief of renal pain associated with small hydronephroses. It is usually but not always successful and most of the cases have been reported as though no very close study had been made of the cause of the retention. It has not yet become popular in this country.

[2] Papin and Ambard, *J. d'Urol.*, 1921, xii, 126; *J. Urol.*, 1924, xi, 337.

CHAPTER XLVII

OPERATIONS UPON THE URETERS

The ureters should be reached by extraperitoneal incision. From the kidney pelvis to the brim of the bony pelvis the ureter is best reached by an oblique incision with its central point about three fingers' breadth above the antero-superior spine of the ilium. Through this the peritoneum is pushed back around the loin until the fascia over the psoas is encountered. The ureter will be found attached to the posterior surface of the peritoneum over the mesial portion of the psoas. It crosses the brim of the pelvis at the point of bifurcation of the iliac vessels. At this level it will be found lying internal to the sheath of spermatic, or ovarian, veins which are readily identified on the peritoneum. The ureter crosses behind these veins at about the level of the fourth lumbar vertebra and above this lies external to them. It is to be identified readily enough if small, and more or less normal, or if thick and inflamed, but if very thin and greatly dilated, it may be mistaken for a small intestine.

Even the uppermost portion of the ureter may be exposed as it runs just internal to the lower pole of the kidney without dislocating this viscus from its bed.

The pelvic portion of the ureter has been approached through the vagina, the rectum, the perineum and by the parasacral route. None of these has been very generally employed.

Stones in the intravesical portion of the ureter or strictures at that point which exhibit a dilatation of the ureter, visible within the bladder, may be attacked transvesically by placing the patient in Trendelenburg position, opening the bladder, retracting it well and slitting the wall of the ureter over the stone or above the stricture and subsequently catching the ureteral mucosa to that of the bladder by one or two sutures of fine catgut on each side, technically ureteral meatotomy.

The pelvic portion of the ureter should not be attacked through the bladder but by an extraperitoneal lateral exposure.

A favored incision is a vertical one through the rectus muscle on the side on which the stone is located. The bladder is sufficiently distended to be readily identified, and the incision carried either through or external to the rectus until the retroperitoneal space is reached. Young employs an oblique muscle-splitting incision. I very much prefer the larger exposure obtained by Gibson's demi-Pfannenstiehl incision. The patient is put in a slight Trendelenburg position, the skin incised in a curve with its convexity downward from a point one-third of the way from pubes to umbilicus to a point two fingers' breadth above the

anterosuperior spine of the ilium. The superficial fascia is incised in this line down to the muscles. The external oblique is split and, if necessary, the anterior sheath of the rectus divided transversely. The internal oblique and transversalis are divided just external to the point where they unite to form the sheath of the rectus. The transversalis fascia is divided. The peritoneum is lifted from the lateral and posterior abdominal wall until the psoas muscle is reached, the bifurcation of the iliac artery identified and the ureter found internal to the spermatic vessels and just over the bifurcation of the iliacs. The expert finger will be able to follow the ureter down to its insertion in the bladder without separating it from its fascial attachments. The operation is habitually for stone and the stone is habitually large enough to be felt as the finger reaches it. By making the dissection along the posterior surface of the ureter, there will be no danger of tearing the uterine artery in the female. In the male the seminal vesicle which lies below and behind the ureter at its insertion in the bladder, and the vas deferens, which has curved around to lie internal to it, are rarely felt.

Reoperation upon the lower ureter is tedious. The old scar must be skirted until the ureter is reached and this must be liberated without damaging the great vessels. If the peritoneum is opened at an inaccessible point near the proposed point of opening the ureter, the operation should be abandoned, lest fatal peritonitis ensue.

URETEROLITHOTOMY FOR STONE

The position of the stone will have been located by urogram. A movable stone will be suspected if the shadow is a peculiarly round one, if it changes position considerably on different plates without intervening colic or if there is more than one stone in the ureter, for in that event, the lowest stone is likely to be the only fixed one. If movable stone is suspected, the x-ray will be repeated immediately before operation and the ureter exposed and compressed by an Allis clamp both above and below the point where the stone is supposed to be before attacking it.

If the stone is not found at the point indicated by the x-ray, the ureteral dilatation and the size of the stone will suggest whether this may have moved up to the kidney pelvis or whether it is simply so small or so surrounded by adhesions as to be difficult of location. If the stone has slipped back into the kidney pelvis and the patient's condition warrants, a second incision may be made in the loin to expose the kidney pelvis without dislocating the kidney and to extract the stone through its posterior surface, otherwise the operation must usually be discontinued, though I have once captured a movable stone at the pelvic orifice of the ureter by gall-duct forceps.

As a rule, when a stone cannot be found, it is not movable but hidden. A longitudinal incision should be made in the wall of the ureter above the stone and a vertebrated ureteral probe passed down the duct until the grating of this

against the stone announces its presence. If this is done, an effort should be made to extract the stone by freeing the posterior surface of the ureter down to the point where bulb and stone are in contact and then endeavoring to pass the bulb beyond the stone and with the finger outside the ureter hold it there until the stone can be pried loose and brought up into the wound, even though the wound be some distance above. By this simple means the smallest calculi can sometimes be followed the whole length of the ureter. Thus on one occasion, I did a pyelotomy for stone and in removing this was surprised to find the ureter below considerably relaxed. A wax bulb was introduced down to the bladder which it entered after the usual hitch at the bladder wall. On withdrawing it, the ureter at this point seemed to grasp the instrument to an unusual degree and as the catheter was pulled to and fro several times, the depth at which the obstruction existed seemed to diminish. As soon as it reached the pelvic brim, the posterior surface of the ureter was freed and by a combination of pressure on the ureter outside and the bulb within, a very small rough oxalate stone was delivered through the pyelotomy incision.

The larger the stone, the less one may expect to remove it by such means and the more readily is it found *in situ*. The incision in the ureter to deliver the stone must always be longitudinal and placed a little above the stone.

After removal of the stone by forceps, the ureter below is distended to 16 F. but no catheter is tied in. The little wound in the ureter wall is closed with plain catgut and a cigarette drain left to this point.

Suture without drainage has been advised but this runs a foolish risk of retroperitoneal cellulitis through infiltration of the infected ureter. Moskowitz reported a case of bilateral simultaneous ureterotomy drained by tube on each side and complicated by hemorrhage from the iliac artery on each side as the drain was removed. To guard against such an accident the pelvis should always be drained by rubber tissue, not by a hard tube.

After Treatment.—The important postoperative complication is silent destruction of the kidney by back pressure from stricture at the point where the stone was impacted. As a general rule, one should catheterize the ureter with a number 10 F. catheter before the patient leaves the hospital and again a year later. If pyuria persists, this is usually attributable to ureteral stricture and should be treated accordingly.

PLASTIC OPERATIONS

For the last thirty years occasional reports have been issued showing excellent immediate results from various plastic operations upon the ureter, notably for the relief of hydronephrosis. It is not yet clear what proportion of these relapse later. It is certain that the surgeon who sees very few cases of hydronephrosis cannot expect brilliant results. Scholl and Judd have reported twenty-eight cures in thirty-nine cases and Wildbolz thirteen successes out of fourteen. In four, he simply released adhesions about the upper ureter and performed

nephropexy. In three, he split a spur at the high implantation of the ureter in the kidney pelvis and sutured the ureteral wall to the dilated pelvis in reverse direction, as in the Heinicke-Mikulicz pyloric resection. Twice he divided the ureter and reimplanted it into the kidney pelvis at its lowest point. Five had ureteral retention due to an artery running to the lower pole of the kidney. Two of these were relieved by freeing adhesions and nephropexy. One has remained well, the other relapsed and required nephrectomy. Three others were

FIG. 125.—URETEROPLASTY OR PYELO-URETEROTRESIS.

The stricture is incised longitudinally and two sutures are inserted. (After Morris)

FIG. 126.—URETEROPLASTY OR PYELO-URETEROTRESIS.

The sutures are drawn so as to make the incision transverse. (After Morris)

treated by division of the ureter and reimplantation of this into the kidney pelvis after the technic employed for reimplantation of the bladder. All of these recovered.

In the discussion of this report, Marion pointed out that he had frequently divided the artery running to the lower pole of the kidney in such cases and had only once noted any clinical evil effect. In this case, a temporary fistula was doubtless due to a necrosis opening the kidney pelvis.

It is not possible to-day to decide which is the better operation. Only an expert should attempt the ureter reimplantation. Even the splitting of the spur does not always give a satisfactory result since the ureter itself is not dilated and makes a very poor conduit for the urine. Quinby insists that one essential condition to success is that the tissues operated upon shall seem grossly uninfected.

It is essential that the kidney pelvis shall be drained by tube from some other

point than the site of resection for at least eight days, and that sutures—non-penetrating—of chronic gut support all tension and that the penetrating sutures be of plain catgut.

Operation for Stricture of Ureter

The worst stricture of the ureter I ever encountered[1] has been relieved for ten years—solitary kidney, clear urine—by intubation after the same technic as is employed to bridge a defect in the biliary ducts. The stricture was excised dividing the ureter and leaving a defect about 1 cm. in length. This was filled by a 16 F. rubber catheter inserted through a small pyelotomy wound and carried down sufficiently far in the lower segment of the ureter to be sure that this would not slip away. No sutures were used to hold the catheter in the ureter except one at its entrance to the kidney pelvis.

Resections of the ureter do not often give such good results. The scar causes the same rebellious type of stricture that is left in the urethra by division of that canal. An attempt has been made to minimize the recontraction of the scar by turning back a cuff of the upper dilated portion of the ureter and stretching the lower portion to suture around the outside of this. As a rule, the failure to perform ureterostomy results in subsequent nephrectomy for pyonephrosis.

Completely obstructing strictures at the lower end of the ureter may be found not to obstruct so completely from above downward and ureterotomy sometimes permits the passage of instruments which will make way for subsequent cystoscopic dilatation.

Ureterocystoneostomy.—The reimplantation of the ureter into the bladder is described in connection with resection of the bladder.

CUTANEOUS URETEROSTOMY

The parietal incision is an oblique one from the outer edge of the rectus to the midaxillary line, its center about two fingers' breadth above the anterior superior spine of the ilium. The ureter is disclosed as in operating for stone in the pelvic ureter. It is followed down as far as possible and freed from the peritoneum, clamped, divided and the lower end ligated. The cut end of the ureter is then brought out of the wound near its upper end. If there is a tendency to kink, it is freed throughout its abdominal course until it lies in an unrestricted curve, its cut end protruding about 2 cm. from the upper end of the incision or from a puncture wound in the abdominal wall situated at a more convenient point. The end of the ureter should come out at about the anterior axillary line midway between ribs and pelvis. It should be held in place by a single suture to its wall on the side opposite that on which the artery runs. There should be no tension and no kinks. The protruding end should be slack.

[1] *Am. J. M. Sc.*

European surgeons advise that a small catheter be left in the ureter. This sometimes causes grave sloughing and I prefer to catheterize once a day during the patient's stay in the hospital or as much oftener as seems necessary.

Immediately after operation, the end of the ureter that lies outside the abdominal wall will slough.

The after treatment is most important. The patient must be seen regularly in order to dilate or resect the cutaneous orifice of the ureter as soon as it begins to contract. No means has been found to prevent this contraction. Although a number of cases have been reported with what is called normal kidney function years after implantation, they all have somewhat dilated ureters and a somewhat reduced function. They have all been through attacks of pyelonephritis. They should be within reach of their urologist who can dilate the ureteral orifice as often as necessary.

The urine is drained off through cup and tube. Most patients prefer metal cups made out of tea strainers, etc., to anything they can buy.

INTESTINAL URETEROSTOMY

The implantation must be made entirely without tension.

The exclusion of a loop of intestine to form an artificial bladder has proven almost universally unsuccessful.

The ureter must be implanted obliquely if intraperitoneal implantation is attempted.

The cause of failure is either leakage at the point of union or ascending infection of the kidney. This almost inevitably occurs just as it does after ureteral implantation into the skin, but with this difference, that it is impossible to provide adequate drainage with the ureter mouth lost in the bowel. The majority of operations have proven fatal.

The excellent results had at the Mayo clinic by the Coffee technic have been noted.

Coffee's original operation is described as follows:

"First, the duct is located and ligated with linen or silk. It is then cut in two above the ligature and the edges caught and held with mosquito forceps while one wall of the duct is split down with a pair of scissors. A linen suture is now passed through the split end of the duct so as to include about one-half of it, and tied. The linen thread is then thrown around the other half and tied. The loose ends are then threaded into two needles. By this method the full strength of the duct is retained for traction, while the opening is maintained by the split. The end of the duct is now wrapped with gauze while the intestine is prepared for its reception, which is done as follows:

"The part of the intestine desired is picked up and an incision made down through the peritoneal and muscular coats, including submucous tissue until the mucous membrane pouts out through the incision (Fig. 127). This incision should be about one inch long or more. Second, five or six sutures are passed

which pick up the peritoneal and muscular coats on each side of the incision. The suture at the upper end of the incision is tied as a control suture. The intermediate intestinal sutures are lifted up on the flat handle of an instrument as they cross the incision. Now the intestine is brought down close to the end of the split duct and the two needles carrying the threads, for traction sutures, on the end of the duct are passed beneath the four or five intestinal sutures and through the stab wound in the mucous membrane into the intestinal lumen and out through the intestinal wall three-quarters of an inch farther along the intestine, and one-eighth to one-quarter inch apart. By making tension on these threads and at the same time pushing the intestine toward the duct, the duct is drawn beneath the intestinal sutures through the stab wound into the intestinal lumen, when the two ends of the threads on the duct are

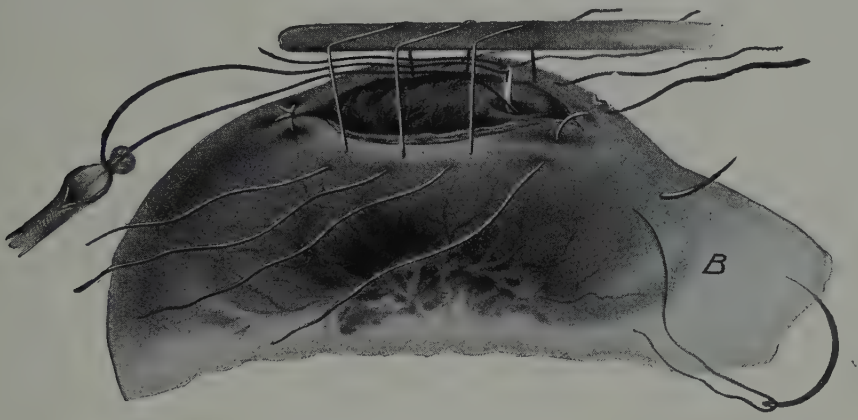

FIG. 127.—URETERO-INTESTINAL ANASTOMOSIS. (Coffee)

tied on the outside, thus anchoring the end of the duct on the inside of the intestine at this point (Fig. 127). The intestinal sutures are then tied. After this operation the duct lies just beneath the mucous membrane, which has been loosened for approximately three-quarters of an inch of its course, so that it slides easily in its new channel. It is therefore necessary to tack the ureter to the peritoneum of the intestine near its point of entrance by two or three fine linen or silk sutures. Care should be used to take only the outer coat of the ureter in the bite of these sutures."

In Mayo's report two notable variations from the Coffee technic are recorded. The split end of the ureter is caught in a catgut suture and the short end of this is pushed 5 cm. up the ureter so as to maintain by capillarity the patency of that part of the duct that pierces the wall of the gut. In the second place, the outer wall of the ureter is caught in the bite of alternate stitches that draw the muscular coats of the gut together after the implantation has been made.

Coffee has modified his technic [2] chiefly by inserting tubes into the ureter, and out through the anus, to maintain their patency. The sloughing that such

[2] *Northwestern Med.*, 1925, XXIV, 211.

tubes cause when left in the ureter that is transplanted into the skin would lead one to be very slow to adopt this modification of technic.

MAYDL'S OPERATION

In 1894 Maydl[3] reported his first cases of ureterotrigonal anastomosis. This operation consists of the implantation into the colon, not of the ureter itself, but of the bladder wall surrounding the mouth of the ureter. The operation has usually been employed for exstrophy of the bladder, and is performed as follows: A ureteral catheter is introduced into each ureter and an elliptical section surrounding the mouths of both ureters is then cut from the bladder wall, great care being taken not to injure the ureters. Next, the peritoneal cavity is opened. A convenient loop of the sigmoid flexure or of the rectum is selected and brought out of the abdominal wound. The ureters, with their attached portion of trigone, are then freed, a longitudinal incision is made in the wall of the gut, with the necessary precautions, and into this the section of trigone is sutured. The remainder of the bladder is now stripped of its mucous membrane and the abdominal wound closed as tightly as possible, with splitting and transposition of the recti, if necessary. As a final precaution the sphincter ani is stretched and a tube inserted and left in for several days to establish drainage and to minimize the danger of leakage and renal retention.

The immediate mortality from shock and infection is at least 25 per cent. Yet the operation continues to enjoy a popularity founded upon the hope that springs external in the ambitious surgeon's breast.

PETERS' OPERATION[4]

This modification of Maydl's procedure consists in dissecting out each ureter separately with its surrounding bit of trigone, and implanting each in a separate hole punctured in the anterior rectal wall immediately behind the wound made by freeing the ureters, the whole operation being extraperitoneal. The ureter ends hang free in the rectum. The ureter catheters are immediately withdrawn and the sphincter stretched to prevent back pressure.

Great care must be taken not to open the peritoneum. If this is avoided and the ureters simply dropped into the bowel without tension, the operation is not dangerous and secondary fatal renal infection is unlikely. The rectum rapidly accommodates itself to the pressure of urine.

URETEROVESICAL ANASTOMOSIS

Reimplantation of the severed ureter into the bladder is usually an intraperitoneal operation, the success of which is conditioned by, (1) absolute freedom from

[3] *Wien. med. Wchnschr.*, 1894, xliv, 1113, 1169, 1209, 1256, 1297, and Mayo, *Ann. Surg.*, 1913, lviii, 133.

[4] *Brit. M. J.*, 1901, June 22.

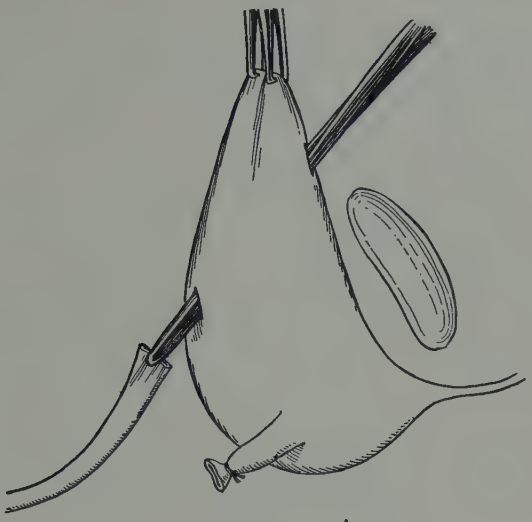

FIG. 128.—URETEROVESICAL ANASTOMOSIS.

Bladder elevated with two Allis clamps. Forceps have been passed through and the cephalad portion of the ureter grasped in the forceps. (Furniss)

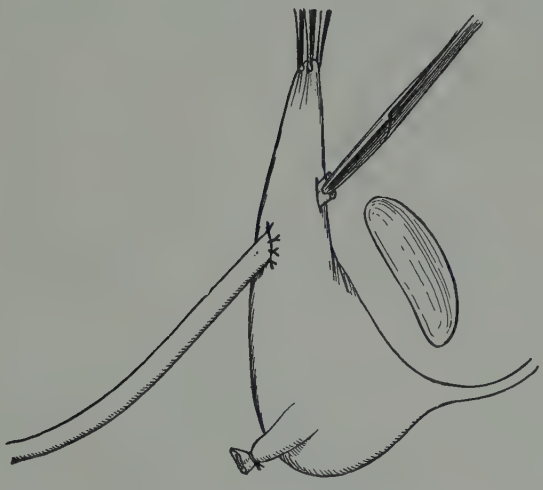

FIG. 129.—URETEROVESICAL ANASTOMOSIS.

Ureter drawn through bladder and united to posterior wall by separate sutures of silk. (Furniss)

tension of the parts anastomosed, (2) splitting up of the end of the ureter so as to prevent stricture at this point, (3) postoperative drainage of the bladder for a week.

If the ureter has been divided in the course of a resection of the bladder, the reimplantation is of course made extraperitoneally and one follows it by rubber

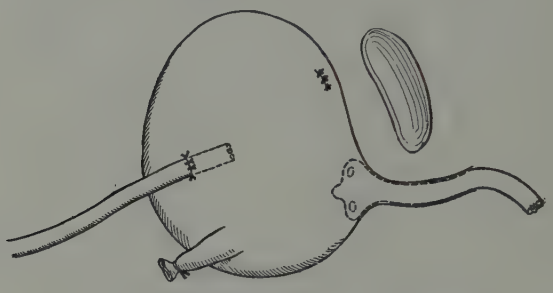

FIG. 130.—URETEROVESICAL ANASTOMOSIS.
This shows: Ligated ureter; ureter sutured to bladder; closure of puncture of anterior wall; retention of catheter in bladder. (Furniss)

tissue drainage outside of the bladder to the point of implantation, under which conditions suprapubic drainage of the bladder is not absolutely necessary.

Figures 128, 129, and 130 represent Furniss's method of intraperitoneal implantation. The illustrations do not show the splitting of the ureteral end and they violate the usual plastic rule of economy of suture. Some operators prefer to attach the duct to the bladder with only one suture, though when the operation is done intraperitoneally, safety requires more.

CHAPTER XLVIII

ANATOMY OF THE BLADDER; SUPRAPUBIC OPERATIONS

The bladder is a muscular sac lying, in the male, between the rectum and the pubes when empty, and distending, when full, into an oval bag occupying more or less of the hypogastrium. Its position is fixed below by the urethra, by the pelvic fascia, as puboprostatic and inferior vesical ligaments, and by the rectovesical fascia, which binds the prostate and the neck of the bladder to the rectum. The muscular tissue of the organ is covered on the outside by peritoneum, on the inside by mucous membrane.

Above and on the sides the peritoneum covers the bladder, which leaves the abdominal wall above the symphysis and passes over the bladder and thence to the lateral pelvic walls and rectum. Thus no trocar or aspirating needle may reach the empty bladder, lying contracted behind the pube, without traversing the peritoneal cavity.

Very different, however, is the condition of the viscus when distended. The distended bladder carries up the peritoneum, so that in extreme retention a distance of 2 to 5 cm. above the symphysis becomes bare of peritoneum. Hence the election of the region *immediately* above the pubes for aspiration of the bladder.

The relation of the peritoneum to the bladder also varies behind. When the viscus is distended the peritoneum barely reaches the blind ends of the seminal vesicles; when empty it descends between them almost to the prostate.

The shape of the bladder varies with age. The bladder of an infant is ovoidal in shape, with its long axis running downward and a little forward, and its apex at the urethral orifice. It lies, when full, almost entirely out of the pelvis. As age advances the bladder sinks into the pelvis, assumes an almost spherical shape when filled and possesses a flattened floor in the region of the trigone. The uterus depresses the dome of the female bladder and widens its cavity laterally.

The muscle of the bladder is composed of two coats. The external or longitudinal coat consists of numerous fibers running from the prostate up over the fundus, where they are met by a similar set of fibers from the anterior surface. At the place of meeting there is a swirl or "cowlick" of muscle-fibers. Over the sides of the organ the longitudinal layer is thin and unimportant. Its fibers are closely connected with the prostate and the deep layer of the rectovesical fascia, and intermingle with the deeper layers of the bladder muscle. The inner layer forms the bulk of the vesical muscle. Its fibers are densely interlaced and have a generally circular character.

The *trigone* of the bladder is part of the urethra.

The mucous membrane of the bladder is of a pale salmon color, covered

by a stratified pavement epithelium, and lies in folds when the bladder is contracted, except over the trigone, where it is always smooth. The glands are few and occur almost exclusively on the trigone. They are exceedingly small. A little lymphoid tissue is usually found irregularly distributed in the mucosa. The coats of the bladder are united by connective tissue, which is everywhere loose, except at the trigone.

The bladder is arbitrarily described as being composed of a *vault,* two lateral walls, a *fundus,* the pouch behind and above the trigone, and a *trigone.* The urethral orifice is often spoken of as the bladder *neck.* The ureters pierce the floor of the bladder obliquely and open at the lateral angles of the trigone.

The *arteries* of the bladder are the superior, middle, and inferior vesical. They anastomose freely. The *veins* are numerous and lie in three planes—the subserous, the intermuscular, and the submucous. They anastomose freely with one another and with the prostatic plexus, and the plexus of Santorini above the neck of the bladder. They empty into the hypogastric veins. The *lymphatics* run chiefly beneath the mucous membrane and empty into several small groups of glands lying about the bladder itself and thence into the iliac glands along the internal and common iliac vessels. The *nerves* are derived from the third and fourth sacral by way of the hypogastric plexus.

The fetal bladder is connected with the allantois by the *urachus.* This canal persists as an unimportant fibrous, subperitoneal cord which connects the vault of the bladder with the umbilicus. The peritoneum meets the bladder and is quite adherent to it, just behind, or, if the viscus is distended, above the point of attachment of the urachus.

SUPRAPUBIC OPERATIONS UPON THE BLADDER

The choice of anesthesia for bladder operations is a wide one. Ethylene is the best general anesthetic unless the cautery is to be used. I have long fancied a local anesthesia obtained by direct infiltration of the wound with 1 per cent novocain for the skin and one-quarter of 1 per cent for the deeper tissues. Block anesthesia of the abdominal wall is obtained by injecting at least 10 c.c. of ½ per cent novocain solution into the subcutaneous tissue and an equal amount beneath the sheath of the rectus at each of three points, *i.e.,* just above the pubes, midway to the umbilicus, and opposite the umbilicus, on each side. I have not employed this anesthesia.

Anesthesia of the prevesical space is obtained by the infiltration of about 3 c.c. of novocain solution before the operation is begun.

Local anesthesia of the bladder is relatively unsatisfactory. Surface anesthesia is obtained by injecting 10 c.c. of 1 per cent novocain into the empty bladder ten minutes before this is distended. The bladder wall must be anesthetized by infiltration before it is cut.

I have not employed local anesthesia for any extensive operations or for suprapubic prostatectomy, as other types of anesthesia are preferable.

Spinal anesthesia is admirably suited to all bladder operations. For suprapubic operations the puncture should be made in the second lumbar space. For the last five years I have used capsules containing 120 mgm. of novocain crystals as anesthetic without any fatalities and with only one temporary partial paralysis which amounted only to weakness of the legs and cleared up entirely in three months.

During the past year my technic has been the following: One hour before operation 75 mgm. of ephedrin by mouth and 1 : 200 grain of hyoscin under the skin. A special nurse stays by the patient and keeps him absolutely quiet. As he leaves his bed for the operating room, a hypodermic of morphin is given. During operation blood-pressure is taken every ten minutes and if the systolic pressure falls to 90 or to within ten points of the diastolic, 5 minims of adrenalin are given subcutaneously. The ephedrin controls the fall of blood-pressure to so great a degree that one very rarely sees the pallor and vomiting which were commonplace before it was introduced.

Sacral anesthesia is entirely inadequate for suprapubic work and in as much as this anesthesia does not always cover the whole bladder, I prefer ethylene or spinal for prostatectomy, though the combination of sacral for the prostate and block for the abdominal wall has been much used by the Mayos.

The Parietal Incision

The transversalis fascia at or about the level of the umbilicus splits into two layers, the more superficial of which continues down behind the abdominal wall. The deeper layer follows the peritoneum to its bladder attachment and then extends over the anterior surface of the bladder, forming a fascial sheath to the dome of that organ under which run the large vesical veins.

The space between these two layers of fascia is filled with fat and is known as the prevesical space (space of Retzius). It is continuous on each side with the pelvic cellular tissue. This space is the one noteworthy landmark in approaching the bladder through an incision in the abdominal wall.

Suprapubic cystotomy may be performed through a transverse or a transrectus incision, but is commonly done in the mid-line. The skin incision may reach to or above the umbilicus though it is often possible to keep the upper end of the incision well below the umbilicus, so that the deeper parts will not be opened above the level of the semilunar fold in the posterior layer of the sheath of the rectus. Thus we minimize the risk of postoperative hernia.

But the lower end of the incision must extend into the mons veneris so that the anterior sheath of the rectus can be split to the pubes. It is essential that this be done and done with care. If the sheath is not split to the pubes, a little pocket remains beneath it from which it is not easy to drain accumulated secretions. And, if it is split not only to, but also into the pubes, a pubic periostitis may result with necrosis of bone beneath, which may cause considerable pain and delay healing quite indefinitely. Such an accident should never occur.

After splitting the anterior sheath of the rectus as nearly as possible in the mid-line, the actual linea alba is found by tracing the fibers of the pyramidalis muscle, which run downward and outward from the linea alba to the pubis, and by gently pressing the fibers of the rectus to one side with the handle of the scalpel. The side to which they are adherent (and inserted) is the linea alba. It will usually be found that the median incision has been made between the linea alba and the side of the patient on which the operator stands.

As soon as this has been identified, with a few strokes of the knife the rectus is separated from the mid-line and the pyramidalis is also cut away, leaving an opening that begins just above the pubic bone.

The transversalis fascia is now nicked and separated, revealing the prevesical fat. If the bladder has been distended before operation, it may be detected as a tense globular mass beneath the prevesical space. It is my practice to distend it after the transversalis fascia has been cut. As the bladder is being distended, two fingers in the wound will detect its rise until it has reached an appropriate height. The muscles and fascia are then retracted laterally, care being taken at this time to make *no dissection in that part of the prevesical space that goes down behind the pubes.* All dissection must be kept high up on top of the bladder so as to open the deeper pelvic plane as little as possible.

With the bladder full and presenting in the wound, the loose fatty tissue over the deeper layer of the transversalis fascia is mopped away laterally and downward. This exposes the posterior layer of transversalis fascia under which run the large veins surrounded by more or less fat. If the patient is thin, one does not detect this layer of fascia without looking for it, for the bladder muscle is plainly seen through it. But it is convenient to pick up and slit this fascia with some precision, for after so doing, the vertical veins that run over the vault of the bladder can be pushed to one side and required to be ligated in no more than one or two places.

The subsequent procedure depends upon the operation that is contemplated. It is always wise to push back the fascia and veins laterally off the dome of the bladder as far as possible, so as to give ample space for subsequent sutures to invert the bladder wall. If the operation is done in this deliberate manner and the bladder identified by seeing its bundles of muscle-fiber, the position of the peritoneum may not be clearly identified unless the patient coughs or strains, thus pushing it down. But opening of the peritoneum is not even a complication of the operation so long as the surgeon realizes what he has done. Before opening the bladder the peritoneal cavity is to be sutured without drainage, eliminating unnecessary contamination.

Prevesical Section

Prevesical section is an operation devised as a substitute for the "two-stage" prostatectomy and as the preliminary to suprapubic lithotomy.

The bladder is exposed as above described and fastened with a stay suture

of chromic gut which attaches the root of the urachus to the two recti. Below this suture the wound is stuffed with acriflavin gauze.

Two days later the pelvic fascia will have become so adherent that the bladder may be opened without any danger of pelvic cellulitis.

I have performed this operation a number of times in the last six [1] months and have been delighted to note that the shock and rise of temperature after this operation are not greater than after a subsequent prostatectomy; also that prevesical section quite eliminates the 15 or 20 per cent mortality of preliminary cystotomy.

Prevesical section as a preliminary operation should replace intraperitoneal cystotomy as the operation of election for the removal of large vesical calculi. It should also prove occasionally serviceable for diverticulectomy and resection for tumor.

The ideal interval between prevesical section and subsequent cystotomy is two to four days.

Reoperation

One frequently has occasion to open a bladder through the scar of a previous wound. The first step in such an operation is to excise the scar in the abdominal wall. If there is ventral hernia, the sac is dissected free before any attempt is made to enter the bladder and opened and excised down nearly to its attachment to the bladder, then working both inside and outside the sac, it is possible to free it from its adhesion to the vault of the bladder as far as is necessary. Peritoneum is then closed with plain catgut and without drainage, the line of suture protected by a gauze pad which is to be renewed as soon as it is wetted.

When there is no hernia and therefore no excuse for opening the peritoneal cavity, the dissection beneath the recti is kept just above the pubis and the bladder distended as high as possible. In as much as the bladder muscle is scarred by operation and perhaps by disease, one must be prepared to enter either the bladder or the peritoneum without warning. I have never entered the two simultaneously. Whichever is opened first, guides us to the position of the other. Sometimes one may elude the scar by lateral dissection.

If one becomes lost in scar, the peritoneum should be immediately opened well above the bladder and the finger inserted into the peritoneal cavity to distend the peritoneal reflexion from the bladder which is then readily separated on each side from the bladder wall and finally in the mid-line until the vault of the bladder is free. All holes in the peritoneum are then sutured without drainage before opening the bladder.

That the bladder and the peritoneum should be accidentally opened at the same time is no complication if the operation is being done deliberately. The opening of the bladder is a signal for closing the peritoneum and no matter how

[1] Neff (*Southern M. J.*, 1928) has reported ninety operations. Williams (*Am. Surg.*, June, 1916) originated the operation.

much the peritoneum has been soiled by urine, it should not be drained. It will protect itself better if mopped dry and sutured tight and the patient put in Fowler's position after the operation.

Suprapubic Cystotomy

After the antiseptic preparation of the patient has been completed, a catheter is introduced into the bladder through which about 30 c.c. of 1 : 1,000 acriflavin are injected. The catheter is then clamped and its clamped end left lying in a sterile pus basin, the genital region so covered with towels that the catheter will be readily accessible.

If prevesical section has been performed, the stuffing is pulled out of the wound, its sides retracted with narrow retractors and the stay suture in the bladder recognized by palpation. (If prevesical section has not been done, the abdominal wall is opened and the prevesical space entered.) An assistant now takes a large bulb syringe and slowly injects air into the bladder, while the operator's finger on top of the bladder notes the distention of this organ. The acriflavin acts both as an antiseptic and as a medium which will prevent air embolism from the prostatic and trigonal region. The suprapubic palpation detects the distention of the bladder and, as soon as the dome of this organ is rounded, it is ready to be opened.

The distended bladder is now seized on either side of the mid-line with Allis clamps and the vertical fibers of muscle are split. If the bladder wall is thin, the muscle will seem no more than ½ cm. thick; if hypertrophied, it may seem four times this thickness. As the incision is carried down through a thick wall, its muscle should be retracted by following down the sides of the incision with Allis clamps.

The submucosa of the bladder is extremely lax. The last fibers of muscle may be cut through without opening the mucosa. This is pushed away by the edge of the knife and then bulges into the wound. In order to do a neat operation, care should be taken not to cut the mucosa inadvertently but to discover its bulging dark bubble and to identify it by grasping with Allis clamps the deepest muscle-bundles on either side (Fig. 131).

The bladder is then deflated by taking the clamp off the catheter in the urethra and gently expressing as much of its contents as possible by pressure on the vault. During this maneuver, the Allis clamps must be very lightly held lest they be pulled off the friable bladder muscle.

With the bladder partly empty, the bulging of the mucosa disappears and it is very difficult to distinguish it from the surrounding muscle unless it has been carefully identified by clamps on each side.

The bladder is then perforated with a swift stroke and an aspirator introduced, with which the bladder contents are evacuated. As this is withdrawn, the edges of the mucosa are caught to the bladder muscle on each side with Allis clamps and the clamps previously placed are removed.

This system of opening the bladder minimizes infection of the prevesical space. This is unimportant if prevesical section has been performed.

Subsequent proceedings depend upon whether the interior of the bladder is to be inspected or not. If, for example, a stone is to be removed or a prostatectomy done, the bladder is quite sufficiently open for that purpose if it will admit two fingers.

But if the interior of the bladder is to be inspected for tumor, ulcer, diverticulum or ureteral catheterization, the incision must be enlarged upwards—never downward toward the pubes. Now in as much as the original incision in the vault of the bladder has been made very close to the implantation of the urachus, which can be felt as a cord running in the mid-line of the peritoneum, the enlargement of the wound in an upward direction either requires the waste of a few moments to divide and clamp the urachus and carefully elevate the peritoneum below it or else the outer layer of bladder muscle must be spared. It is my practice to gain 2 or 3 cm. in the length of the bladder incision by incising the mucosa upward to that extent, then inserting an automatic retractor, opening this and catching such bleeding points as appear in the muscle.

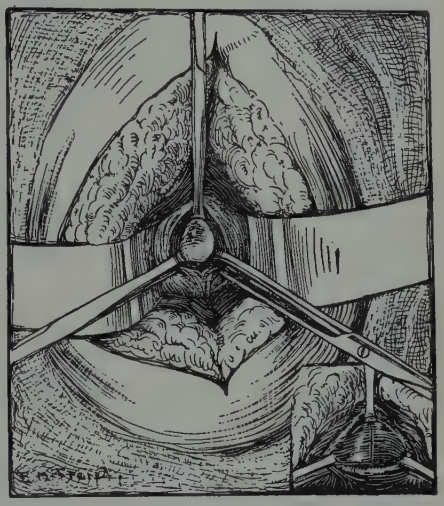

Fig. 131.—Suprapubic Cystotomy.

As the bladder muscle has been slit open it is pulled apart by Allis forceps until the bubble of mucosa is seen. This is the signal for deflation.

Unless a very large incision is made in the vault of the bladder, the automatic retractor does not expose the lesions within the organ unless it is pulled directly away from the patient's bladder after its introduction. Putting the patient in Trendelenburg position is a routine procedure at this time but is often quite unnecessary. It is equally unnecessary to strain at opening the bladder very widely from side to side. All that one need do is to insert the retractor well within the bladder cavity, open it to a moderate degree and pull upward as though one were trying to lift the patient off the operating table. Then a Cameron light is inserted into the bladder and one has full view of its cavity except perhaps for one or two crannies which are exposed by gentle pressure with a sponge stick. In examining for tumor, it must also be remembered that a tumor may be concealed under the blade of the retractor and the examination is not complete until the retractor has been closed and reopened at an entirely different angle so as to expose the portion of the bladder wall previously concealed.

Alternative Technic.—It is not obligatory to distend the bladder or to open it as above described, but I know no other method so neat.

There are various methods of suturing the bladder wall. Lower's technic, which is substantially a subcuticular suture of the mucosa followed by a through and through suture of plain catgut, and a third layer of Lembert sutures is an excellent method, though I fancy the first, or mucosal, layer unnecessary.

Many surgeons never close the bladder entirely. Judd once suggested complete closure after suprapubic prostatectomy but now always leaves a tube in. I feel for certain cases, notably tumors, there is a distinct advantage in complete closure if the bleeding is surely stopped.

Bladder Drainage and Suture

The only reasons for draining a bladder that has been opened suprapubically are three: In order to drain the kidneys, some urethral obstruction not having been removed; in order to provide for the issue of clots of blood too large to escape through the urethra; in order to drain the bladder when the patient cannot bear a urethral catheter.

All other bladders should be sutured without drainage. There is an ancient prejudice against suture without drainage of bladders that are gravely infected. This runs counter to reason. The danger to badly infected bladders is that their infection will be increased by the presence of a suprapubic tube acting as a foreign body.

Do not drain, therefore, if urethral drainage may be depended upon.

If the bladder is not drained, intermittent postoperative catheterization for the first twenty-four hours is safer than the indwelling catheter since this is likely to be displaced as the patient is transferred to his bed. Nine out of ten patients need no catheter at all. The others feel the need but once or twice.

The Drainage.—If gauze packing or a prostatic bag has been left in the bladder after prostatectomy, no further drainage is needed until this has been removed, when it is customary to replace the packing by a 35 F. Pezzer or Malicot catheter, or to drain by urethral catheter.

If no such compression material has been left in the bladder but considerable hemorrhage is anticipated, the large so-called Freyer or Marion tube may be used, through which forceps may be introduced in the bladder to remove any obstructing clots.

When the tube is used for the relief of renal retention, it should be a 24 F. two-eyed catheter.

Tubes are introduced at least 2 cm. into the bladder cavity but no further. Under no circumstances should the catheter be introduced to the bottom of the bladder. In such a position its tip rubs against the trigone and produces constant and increasing irritation.

The tube is to be sutured in the upper end of the wound and held in place by a purse-string suture.

The Bladder Suture.—Stitches that perforate or approach the mucosa of

the urinary organs must be of plain catgut so that they may quickly dissolve before there is time for phosphatic incrustation upon them.

One begins the suture at the lower end of the wound. The bladder is pulled forward and upward by Allis clamps, the abdominal muscles are well retracted. The first suture enters the bladder at the point where the muscle-splitting begins and just catches the mucosa at the lowest point of the incision. A running suture is then carried through the whole thickness of the muscle and the edge of the mucosa on each side to the upper end of the incision. If the incision is long, this suture is either interrupted two or three times or the lock-stitch is used.

At the upper end of the incision, if the mucosa has been split beyond the point of implantation of the urachus, this part must be closed by a separate suture beginning at the top of the incision and running to where it will meet the incision coming up from below.

In order to get a good union, a second layer of sutures should now be taken enfolding the original line of suture. This second line must be taken in the bladder muscle and not in the fat. It may be of fine chromic gut only on condition that the bladder wall is thick enough to assure non-penetration of its cavity by the needle.

Closure of the Abdominal Wall.—The two requisites are a firm union of the parietes down to the bladder and drainage of the prevesical space.

The belly wall is united in the usual manner unless there has been hernia from previous operation. In this event the semilunar fold of Douglas is sought and an effort is made to suture the dome of the bladder to this as a first line of defense behind the recti.

The prevesical space must be drained by rubber tissue or a cigarette even though there is a tube in the bladder. This fascial drain should remain in for at least four days and after its removal the wound should be inspected carefully each day to be sure that the muscles have not sprung together and encouraged an infiltration beneath them. When the bladder is sutured without drainage, I habitually leave a tube as the fascial drain so that if a late suprapubic fistula is established, the urine will find ready exit.

Alternative Technic.—Each surgeon has his minor preferences. For example the Mayos employ an incision that reaches practically from pubes to umbilicus for all bladder operations. By placing the patient in a very exaggerated Trendelenburg position, they expose the interior of the bladder to students much better than can otherwise be done. Many surgeons in reopening the bladder wound, begin the incision to one side or high up so as to get a good plane of cleavage, and there is a general prejudice against opening the bladder if the peritoneum has been opened, especially in secondary operations with a bladder fistula. One opens the peritoneum in about 10 per cent of secondary cases. I have never hesitated to proceed with the operation. I have never recognized a postoperative peritonitis nor has it been suggested by any one else in any of my cases.

Many surgeons do not distend the bladder. For some years I did not but simply grasped its wall with Allis forceps, opened and aspirated. The method above described is far neater and more foolproof.

In closing the abdominal wall, many do not use a cigarette drain to the prevesical space but trust the suprapubic tube for this. I prefer to add a drain to the tube in order to give a capillary leak between the two drains so that there may be no back pressure beneath the recti.

A favored suture is a "figure of 8" including skin, subcutaneous fascia and sheath of the rectus. This is an excellent device for the first suture above the fistula. The other skin sutures I usually make in the form of deep mattress-sutures which pull together the deep fascia but do not reach the sheath of the rectus.

Suprapubic Lithotomy

The removal of a stone through the suprapubic wound is easy, if a stone forceps (Fig. 132) is used, otherwise difficult, just as difficult as it would be to find a substitute for the obstetrical forceps which the stone forceps reproduces in miniature.

The high mortality from suprapubic lithotomy is due to infection of the prevesical space of a patient with low renal function and a very virulent in-

Fig. 132.—Lithotomy Forceps.

fection of the bladder. The problem, how to prevent the bladder infection from reaching the prevesical space, may be solved in several ways. (1) The operation may be done in two stages, like a prostatectomy, but with the first incision reaching only to and not through the bladder wall. Four days later the bladder may be opened and the stone extracted. (2) If the stone is not enormous, the bladder may be carefully opened, the stone extracted and the wound closed tightly and inverted about a tube. (3) If the stone is enormous, it may be removed by Harrington's operation, an intraperitoneal cystotomy. Before operation the bladder is filled with 1 per cent mercurochrome, which is left in for ten minutes and then drained off to the last drop. Then the patient is put in Trendelenberg position, the peritoneum opened, the bladder distended with air and opened through the peritoneum, the bubbles of mercurochrome caught upon pads, the stone extracted with stone forceps, the bladder sutured in two layers, the inner one to the mucosa and bladder wall, with plain catgut, the outer to the bladder wall and peritoneum, turning in the former, with chromic gut. The first suture line must be tested by filling the bladder to learn whether

it leaks and to show where reinforcement is needed, before inserting the second layer. The peritoneum is then closed without drainage. An expert nurse is entrusted with the postoperative catheterization, which must be performed sufficiently often to prevent overdistention of the bladder for two days and longer if necessary, until the patient can pass out the fluid injected. The experiment of permitting him to try to pass water is first made on the third day. He should be catheterized thereafter once a day until he has shown his ability to empty his bladder.

I have employed the Harrington operation but twice. The patients were the oldest from whom I have removed stone and their stones were among the largest I have removed. They both had entirely uneventful recoveries for a week; then one caught cold and promptly died of pneumonia. The other survived. Neither had any wound complications.

Exposure of the Bladder for Resection

Resection of tumor or diverticulum requires an entirely different exposure before the bladder is opened. The object of this is to free the bladder muscle wholly from its peritoneal and lateral fascial attachments, on one side if there is unilateral diverticulum, otherwise on both sides, so that it may be literally lifted outside the belly cavity almost as freely as the inadherent uterus. The operation begins with exposure of the bladder vault as above described, followed by identification of and division of the urachus between clamps. The patient is then put in the Trendelenburg position.

If there are no adhesions, the peritoneum adheres to the bladder only for a space 2 or 3 cm. in cross section just above the urachus. Each surgeon will follow his fancy in attacking this little adhesion from above, laterally or below. I habitually begin by lifting the peritoneum from the bladder on each side of the mid-line. When this dissection has reached a depth almost equivalent to the length of the index finger, the two lateral subperitoneal dissections can be made to meet by blunt finger elevation of the peritoneum in the mid-line of the depth of the wound. One then has only to detach the island of lightly adherent peritoneum lying between the finger in the depth of the wound and the urachus. The peritoneum may be opened inadvertently or intentionally and the iliac vessels and vena cava palpated for glands. The peritoneum is closed without drainage.

One or two sweeps of the fingers now free the rest of the pelvic tissue from the median portion of the bladder down to the seminal vesicles or the top of the diverticulum. But the bladder is not yet mobilized.

The lateral fascial attachments of the bladder contain the middle vesical vessels. These pseudobroad ligaments are readily identified, clamped, cut and tied. A little further blunt dissection now frees the lateral walls and fundus of the bladder right to the prostate and it can be lifted out of the belly unless an adherent diverticulum retains it.

Excision of Diverticulum

The operation may be performed intravesically or extravesically. Young pleads that all diverticula should be removed from within the bladder. Most surgeons feel, however, that all larger diverticula are much more comfortably handled by dissection outside the bladder. In any case, the bladder must be opened.

The operation consists in two parts: (1) Removal of the diverticulum; (2) destruction of the impediment to urination at the bladder neck. This may be a middle lobe or a large prostate. It is usually a sclerotic bladder neck.

If the diverticulum is large or there is no doubt as to its exact size, the distended bladder should be freed from its peritoneal attachments, as already described, down to and as far as possible around the sides of the diverticulum or diverticula before the bladder is opened. Then the diverticulum should be packed with gauze and freed with great care from the peritoneum and the rectum. With patience, one can almost always remove all of the diverticular cavity but every surgeon has probably, at least once in his life, failed to accomplish this, either because of the great size and firm adhesions of the diverticulum or because of the patient's condition. Under such circumstances, one may stop the operation at any moment, by severing the attachments of the diverticulum to the bladder, sewing up the hole thus made in the floor of the bladder, leaving a drain to this point and another to the remains of the sac that may not have been removed.

Before completely freeing the inner and posterior wall of the diverticulum, the ureter on this side should be located. This may be done by inserting a catheter up the ureter, if its orifice can be seen. If the orifice is invisible, the diverticulum should be dissected free excepting its posterior and mesial surface. Upon the lifted peritoneum search is then made for the ureter with the knowledge that the first tube encountered is likely to be the vas deferens. If the ureter is still not found, the gauze should be removed from the diverticulum, its upper wall split and retracted and search continued within the diverticulum and palpation without until the duct is located. The ureter is then freed from the diverticulum and this cut away. If the ureter opens into the diverticulum, a V-shaped flap connecting the ureteral orifice to the adjacent bladder wall can be readily lifted up and incorporated in the reconstruction suture which is of plain catgut.

The urethral obstruction is then identified and relieved.

The bladder is then sutured around a small suprapubic tube, the wound closed with two cigarette drains to the diverticular orifice and to the cavity whence the diverticulum had been removed.

Small Diverticula.—Small diverticula may be conveniently removed from within the bladder. Young does this with suction on a glass tube whereby he inverts the sac. The same thing may be accomplished by seizing the bottom of the diverticulum with Kocher forceps, pulling the mucosa inside out, ampu-

tating it, closing the orifice, leaving a drain down outside the bladder into the cavity of the diverticular wall and suturing the wound in the vault of the bladder around a small tube.

Complications during Operation.—Apart from such complications as tearing of the peritoneum or rectum or incomplete removal of the diverticulum, three special items should be noted:

1. A large diverticulum drains badly and may keep up a vile infection in spite of the ordinary bladder washing. The mortality from diverticulectomy is likely to remain relatively high because of the difficulty of splitting the risk in two as is done in grave cases requiring prostatectomy. There is retention in the bladder as well as in the diverticulum. The bladder retention may be relieved by suprapubic drainage and this may also give the opportunity to put a special small irrigation tube down into the diverticulum but surgeons will always avoid this method of operating because of the resulting adhesions which will interfere considerably with the secondary diverticulectomy. I have not performed diverticulectomy in two stages but I have lost two patients who might have been saved by this operation. Prevesical section may help.

2. Stone in a diverticulum is rarely diagnosed, yet the realization that stones in the bladder always give x-ray shadows that touch each other and that a stone lying apart must be either in a diverticulum or in a ureter, should be enough to establish preoperative diagnosis. The presence of a stone in the diverticulum is not a complication if its presence is known. It is readily lifted out with the stone forceps.

3. Tumor in a diverticulum may be suspected by the vile odor of the urine, for the combination of retention and tumor encourages necrosis and produces a very foul urine. The tumor may be diagnosed by cystogram. Like stone, it is of no great importance if recognized, as the diverticulum can be stuffed and excised in the usual manner, care being taken to remove the diverticulum with the stuffing in it. But if the presence of the tumor is not suspected and an effort is made to invaginate the diverticulum, the tumor may be spread throughout the wound before its presence is known.

4. Injury to the ureter in the course of diverticulectomy is likely to pass unnoticed. If the ureter is known to have been cut and the patient's condition forbids any further operation, drainage by a small tube will take care of the urinary leak from the ureter and permit the relief of this after at least three months have elapsed by intestinal or cutaneous ureterostomy or at an earlier date by nephrectomy. But if the injury to the ureter is recognized during operation, an attempt may be made at implanting the ureter into the bladder wall. If this cannot be done and the kidney is believed to be uninfected, the ureter may be tied off with the prospect of an emergency nephrectomy later in case suppuration declares itself. If the kidney is infected, nephrectomy will usually be required.

After Care.—If the diverticulum has been completely removed, the deep drains should be left in for about a week and the suprapubic tube not removed

until three days after the removal of the drains. But if at operation the diverticulum has not been excised, the drain to this, at the end of a week, should be exchanged for a small soft tube through which the cavity should be kept clean until the bladder fistula has closed, then Carrell-Dakin treatment should be instituted until the cavity has contracted around the tube and is apparently bacteria free. The removal of the tube at this time should be followed by closure of the wound and, so far as is known, the patch of diverticulum wall will give no further trouble.

Resection of the Bladder

The operation will be described as for tumor. Resection for ulcer is a much simpler operation than most tumor resections as the base of the bladder is not involved and the integrity of the ureter is never in question.

The abdominal wall is opened from pubes to umbilicus, the bladder is distended and the patient put in Trendelenburg position. The bladder is then freed down to the trigone and delivered from the abdominal cavity. The wound is protected by pads, the contents of the bladder gently expressed, the bladder opened at a point where no tumor is believed to exist. Through this incision, which is usually fairly high in the field, the aspirator is introduced and the remainder of the fluid sucked out of the bladder. Some tumor tissue will adhere to the sucker; care is taken to remove this without contact at the point of incision in the bladder wall. The incision is then enlarged sufficiently to insert the automatic retractor and with a Cameron light the interior of the bladder is inspected for tumors, care being taken to shift the retractor several times in order to be sure that all parts of the bladder wall have been inspected. The resection is then carried out with the primary object of dividing the bladder wall at all points at least 2 cm. away from the tumor. This incision is best done with the radiotherm cautery and before it is begun all non-infiltrating tumors are destroyed with the cautery point. Great care is taken to prevent contact between any tumor tissue and any cut surface.

If the resection will include the mouth of the ureter, this duct should be identified and isolated down to the bladder wall and divided as low down as practicable so that it may subsequently be reimplanted into the bladder. The defect left by resection of the bladder must be carefully closed with several layers of sutures, the inner ones of plain catgut, the outer ones of fine chromic gut. A cigarette drain is left to the point of resection, a small tube is left in a wound punctured in the roof of the bladder. This should not be removed within ten days.

Complications during Operation.—The tumors may be so large that when the bladder is first opened it is impossible to identify their bases. In most instances, this difficulty may be overcome by gently lifting the tumors with sponge forceps, tightly ligating their bases by a plain catgut ligature such as is used for ligating vessels after tonsillectomy and burning them off. But in

certain instances, after the bladder has been opened, it will be found that the base of the tumor is so large or so close to the neck of the bladder that resection is impossible. Under these circumstances the exuberant papillary growths may be cut away after ligating their bases, the stumps cauterized to prevent tumor implantation into the bladder incision and the bladder sutured without drainage unless there is obstruction at the ureteral mouth, in which case a suprapubic tube must be left in place.

Such large tumors should be diagnosed as unsuitable for resection by previous cystoscopy, cystogram and bimanual palpation and treatment planned either by radium implantation or total cystectomy.

Undetermined Factors.—It is not known whether preliminary deep radiation diminishes the prospect of tumor implantation in the course of a resection. If it is employed, the resection should be performed about two weeks later, after the patient has recovered from the intoxication due to radiation and before the tissues have become indurated by the reaction to the radium emanations.

Beer insists upon the advantage of making all incisions in the bladder by cautery in order to minimize the danger of tumor reimplantation and after resection he fills the bladder with pure alcohol for five minutes before closing it.

Complete Cystectomy

Complete cystectomy implies preliminary anastomosis of the ureters with skin or bowel. The patient should recover from the effects of this anastomosis before an attempt is made to remove the bladder.

The operation is most conveniently performed by a surgeon who is conversant with the perineal procedures for prostatectomy and vesiculectomy by a combined perineal and suprapubic route.

The patient is first put in Halstead's position and the posterior surface of the prostate and seminal vesicles exposed, the urethra divided at the apex of the prostate and the prostate and bladder neck separated from the surrounding tissues as though the operation of perineal prostatectomy for neoplasm was to be performed.

The patient's legs and buttocks are then lowered and the operative field shifted to the suprapubic region and the bladder separated from the peritoneum and its other connections. The dissection is carried down to meet that from the perineum and bladder, prostate and seminal vesicles are removed in one piece, the two vasa being divided at a convenient point.

The large cavity is drained both suprapubically and through the perineum. There are no special complications to be expected from this operation.

Alternative Method.—The general surgeon who has no great familiarity with the perineum may prefer to remove the bladder through the abdominal incision. In doing this he should first liberate the mobile portions of the bladder right down to the prostate and the bladder neck. He will then depress

the prostate, divide the urethra at the triangular ligament and free the lower and lateral surfaces of the prostate from the apex backward.

Implantation of Radium Emanation Seeds into Bladder Tumor

The preliminary cystoscopy and cystogram have determined how many seeds will be needed to cover the area of tumor base. If the tumor is so large that one is not certain as to this, it has been my practice to have ready thirty 1 mc. gold or an equivalent dosage of 2.5 mc. platinum seeds. The needles with which the seeds are to be implanted are loaded beforehand, care being taken to dip the point of each in sterile vaseline, to make sure that the seed does

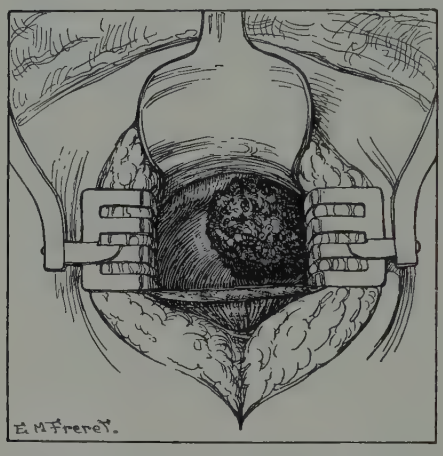

FIG. 133.—SUPRAPUBIC RADIUM EMANATION IMPLANTATION.
The tumor.

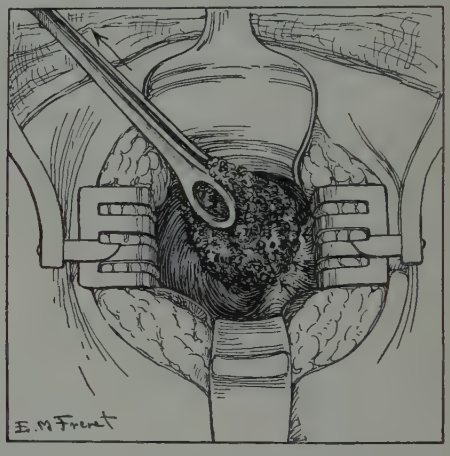

FIG. 134.—SUPRAPUBIC RADIUM EMANATION IMPLANTATION.
The sponge forceps lifts the tumor and exposes its base.

not fall out. As each needle is withdrawn, it is handed to an assistant who inspects it to be sure that the plunger is actually driven home and the seed ejected.

The bladder is opened in the usual manner. Trendelenburg position, automatic retraction and Cameron light are routine. It must not be forgotten that in order to inspect the bladder satisfactorily the automatic retractor must be pulled directly upward, as though to lift the patient off the table. Also before closing the bladder the space under the retractor blades must be inspected for tumor.

Inspection will reveal papillary growth (Fig. 133) or infiltrating ulcer. If there is ulcer a specimen is taken from its raised edge at a point that is surely tumor and not bladder wall for if the mistake is made of trying to remove a piece of bladder wall as a specimen the resulting bleeding is likely to continue after the close of operation and require suprapubic drainage, whereas tumor bleeding will promptly cease.

If there is papillary growth, this is seized with sponge forceps to lift it up so that its pedicle may be caught in with a curved clamp (Figs. 134, 135). This done, the projecting growth beyond the clamp is removed with scissors (Fig. 136) or cautery. If the pedicle is small, it is tied off with a "tonsil suture" and the clamp removed. If the pedicle is large, the clamp is left on until the implantation has been made and then removed with the expectation that the bleeding will be controlled or that a single catgut suture through the base of the tumor will control it.

Small papillary tumors that do not obscure the operative field are not removed. Indeed, the whole operation is planned with the intention of removing the tumors by radium alone. The only exception is when one finds a large

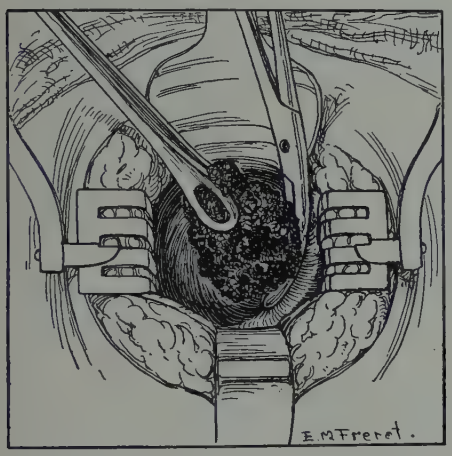

FIG. 135.—SUPRAPUBIC RADIUM EMANATION IMPLANTATION.
The pedicle is clamped.

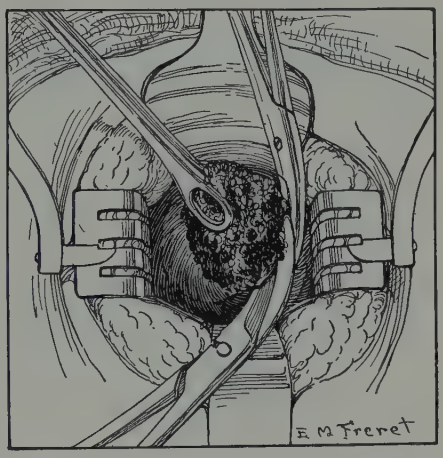

FIG. 136.—SUPRAPUBIC RADIUM EMANATION IMPLANTATION.
The tumor is cut away distal to the clamp (the actual cautery may be used).

number of wee papillary growths. It is much more convenient to destroy these by cautery or fulguration.

Implantation is then begun at the most inaccessible spot, one seed to each corner of each cm. or if the growth is an infiltrating one, to each cubic corner. As the implantation spreads over the extensive surface of an infiltrating growth it is convenient to implant the needles in rows and not to remove one row of needles until the next one has been planted.

The precise limitation of the effect of radium is by no means constant. It can be counted upon within one cm. But beyond this much tumor may be killed. I have destroyed a tumor of the female urethra by radium in the bladder. I have seen tubes placed at a distance from each other of 2 cm. destroy the tumor bases between. One case showed so extensive a multiplication of little low-lying tumors all over the vault that I quite despaired of implanting them all and merely scattered a few seeds about rather casually.

Specimen taken from one of these small tumors was reported carcinoma. Yet the patient survived four years and died of meningitis without known relapse of bladder tumor. Another had so extensive a growth that I exhausted thirty seeds before covering the base. The last few seeds were spaced about the circumference of the growth in the vault. To-day, a year after operation, he is fat and thinks himself well.

Needless to state, other cases have not done so well.

After implantation the bladder is sutured without drainage. Only two excuses exist for drainage; viz., hemorrhage and urethral retention.

The reason for insisting on suture without drainage is that the ulceration that follows extensive irradiation is peculiarly susceptible to secondary infection and very rebellious to local treatment. Some sutured bladders are so thin that they break open toward the end of the first week after operation and remain open for ten days thereafter. After a few days of this drainage the patient, who had previously been very comfortable, begins to have bladder spasms due to mixed infection that may last for weeks.

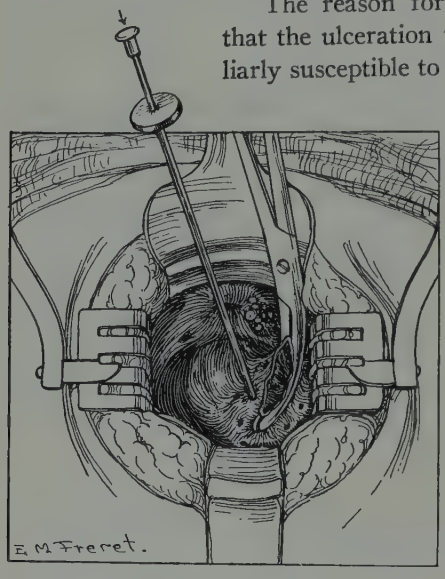

FIG. 137.—SUPRAPUBIC RADIUM EMANATION IMPLANTATION.

Removal of the tumor exposes small secondary tumors on the trigone. Illustration shows points of preceding radium implantation and one needle that has just been plunged into the mucosa and from which the seed of radium emanation has not been discharged.

It is the rule that by the fourth day the patients are distinctly more comfortable than before operation. Many of them consider that they have no postoperative discomfort of any importance. Spasms do not occur without mixed infection unless the amount of radium specified is exceeded or the patient has been previously radiated.

A tube drain is left in the prevesical space for five days to provide for leakage in case this should occur.

After the operation the house officer should be ready to catheterize the patient once, at the end of twelve hours, in case he needs it. Most patients do not. The retained catheter should never be employed. It encourages that very infection we are hoping to escape. If the bladder has not broken open in ten days, the patient leaves the hospital.

Exploration for Rupture of Bladder

The median suprapubic incision should be so planned that the peritoneum can be opened and explored for intraperitoneal rupture of the bladder or other

viscera before the region of extravasated urine is entered. With the peritoneum so opened and the presence or absence of blood or urine noted, the existence of an intraperitoneal rupture of the bladder is readily distinguished by the tear seen in the peritoneum over the bladder after the small intestines have been lifted out of the pelvis.

If an intraperitoneal rupture is found, the patient is put in Trendelenburg position and the peritoneum dissected free from the edges of the tear sufficiently to permit the bladder wall to be plainly identified and sutured in two layers with plain catgut after the peritoneum has been thoroughly mopped clean, but not irrigated.

With a blunt forceps or scissors a subperitoneal canal is then burrowed from the prevesical space to the point of rupture and a strip of rubber tissue inserted into this to drain the bladder wound. Over this in turn the peritoneum is sutured with plain catgut and turned in by a second layer of sutures. No drain should be left in the peritoneum. If the rupture is inaccessible it need not be sutured. Fowler's position after operation.

If the intraperitoneal rupture has existed for several days, the peritoneal symptoms will eliminate all doubt as to the diagnosis. In this case the patient should be kept in Fowler's position both before and after operation and the peritoneum drained for the purpose of evacuating pus and a drain should be left to the sloughing bladder wound.

If no intraperitoneal rupture is found, the incision is extended down to the pubes and if infiltration of blood or urine or pus is discovered here, the infiltrated area is thoroughly opened up by blunt dissection. The bladder is then opened but of course without distending it in the usual manner. The bladder opening is made sufficiently large to permit retraction and inspection, with the patient in Trendelenburg position, of its interior. If the urine is believed to have been uninfected before operation, the suprapubic drainage suffices to take off tension and no special drainage need be supplied for infiltrated areas excepting such as can be easily identified. Wounds in the sides or floor of the bladder may be sutured, if accessible, but this suture is not essential. Drainage should be supplied (*a*) to the bladder by tube, (*b*) to any infiltrated areas that have been opened up by small tubes or rubber tissue wicks. If the bladder can be sutured tight around the tube so that the wound secretions do not enter it, Dakin treatment may be applied to the wound, otherwise not.

If the pelvis has been fractured, loose spicules of bone may be removed but these should not be sought for and the tissues about points of fracture should be disturbed as little as possible until the bladder wounds have healed, after which secondary operations may be required to cause the healing of fistulæ that lead to necrotic bone.

CHAPTER XLIX

OPERATIONS UPON THE PROSTATE AND VESICLES

Choice of Prostatectomy.—See Chapter XXV.

SUPRAPUBIC PROSTATECTOMY

Prevesical section for the purpose of minimizing postoperative pelvic cellulitis, will minimize mortality and greatly diminish the postoperative reaction.

If performed "in one stage" the bladder is opened in the usual manner. For teaching purposes it is well to open the abdomen from navel to pubes, put the patient in Trendelenburg position, retract, illumine and see. Most urologists feel safer to perform the operation relatively blindly through a small incision, though even with a small incision retraction and illumination demonstrate the whole inside of the bladder to the operator. If the wide incision is employed the whole hand is put into the bladder and no counterpressure from the rectum is required to enucleate the gland. I shall describe the operation through the small incision with rectal counterpressure.

The operation begins in the usual manner, with the exception of certain preliminaries referring to the rectal counterpressure. A towel is draped about the external genitals and the sterile sheet brought just below this and depressed between the thighs, the hiatus temporarily covered with a towel. The laparotomy sheet is a nuisance in this operation, its opening is too small. The operator wears upon the hand whose fingers are to enter the rectum an extra glove and sleeve.

As soon as the bladder is opened it should be retracted and illumined to make sure that no tumor, stone or diverticulum has been overlooked. The surgeon then introduces two fingers of the right hand into the bladder and two fingers of the left hand into the rectum. The rectal fingers must be two to balance the prostate, the vesical fingers must be two to fish the lobes loose from their last attachment to the mucous membrane near the verumontanum, though most of the enucleation is performed with one finger.

The fingers in the rectum push the prostate up. A finger is introduced into the prostatic urethra, palpating the bladder neck for sclerosis or carcinoma.

The sclerotic bladder neck feels actually strictured. It grasps the finger tightly, or even tears as the finger is forced through it. The attack upon the sclerotic bladder neck is described below.

The carcinomatous bladder neck feels infiltrated with hard irregular fixed masses characteristically carcinomatous.

In the absence of these the finger meets no obstacle in entering the prostatic urethra except the rounded prostatic lobes against which it bumps. These are palpated and, against rectal counterpressure, the finger in the urethra tears through the mucosa above and near the apex of one of the lateral lobes. This tear must go completely through the mucosa into the line of cleavage beyond, yet it should be made at first very small, only just large enough to admit the tip of the finger. A wide tear so loosens the mucosa that it renders the second tear above the opposite lobe much more difficult to make.

This opposing second tear is then made, and if both have been properly placed a narrow strip of intact mucosa will have been left on the roof of the urethra between them. Beginning at either tear the line of cleavage between the enlarged portions of the prostate and the compressed "capsule" portions of the gland is then sought. The finger is swept through these, tearing the mucosa toward and around the bladder neck as it goes in the line of least resistance, until the mucosal tear passes over the middle lobe, near its apex, and the base of the enlargement is freed. Meanwhile the finger has instinctively palpated the walls of the cavity it is forming. The outer wall is smooth, the inner one lobulated, if the dissection is being made in the right plane.

Now the bladder neck has been torn wide open. The lobes are freed to their apices. A second finger is introduced into the prostatic urethra and the two working together, aided by the rectal fingers, tear through the tough mucosa that still holds the lobes fast to the region of the verumontanum, at their apices. If there is any great difficulty in accomplishing this, withdraw the fingers from the rectum, supply Trendelenburg, retraction, illumination, and with a pair of long scissors cut the mucosa and withdraw the lobes. Cut away any remaining tabs.

If the bladder neck feels tight, split it with scissors.

A large cavity is left from which blood oozes merrily. Spurters should not be looked for, but if they are seen they may be clamped for a minute. Hunt may suture the bladder neck, but let not the novice attempt it. Let him use the Hagner or the Pilcher bag. This is introduced by inserting a 20 F. Béniqué sound through the urethra into the bladder, threading the urethral tube of the bag over this, and drawing it into place. The bag is then distended with water and pulled down into the wound just hard enough to stop bleeding. Five pounds' pressure suffices. If this does not stop the bleeding the bag is not properly placed. Feel around it to find some tab of mucosa upon which no pressure is being made. If the bag cannot be made to press upon this it should be partly withdrawn, the cavity loosely packed with vaseline gauze, and the bag again drawn into place while the gauze is kneaded into the crevices.

The pressure of the bag is painful. It should be removed within two hours. If the Pilcher bag is used one must be careful to let go the urethral tube before the bag is deflated. Before its removal a whistle tip catheter is tied to the tip of the urethral tube so that as the bag is withdrawn the indwelling urethral catheter is left in place.

I usually employ the Pilcher bag and no other suprapubic drain until it is removed, when I insert a rubber tube down to, but not into, the bladder. This prevents the recti from falling together, interfering with drainage and thus favoring pelvic cellulitis. If the bag is not used the suprapubic drain down to the bladder should be put in place as the abdomen is being closed at the end of the operation.

The reason for removing the bag within two hours after operation is that this time suffices to control the bleeding and thereafter the bag merely acts as a foreign body that excites bladder spasm and postoperative hemorrhage.

Suprapubic Prostatectomy in Two Stages.—If the bladder has been drained no longer than a week or ten days, the wound surfaces will readily separate with little danger of tearing the peritoneum, since this has not yet become firmly adherent in the scar. The experienced operator will manage to extract the lobes of the gland in sufficiently small pieces so that the wound is not torn wide open.

If the fistula has existed for longer, there is grave danger that a blind poking in the wound will tear a hole in the peritoneum and kill the patient. One of two courses must be elected. If it is foreseen that the wound will have to be opened widely in order to extract the prostate, the best procedure is to excise the scar down and usually into the peritoneum. As soon as this cavity is opened, the fistula is carefully walled off, the finger introduced into the peritoneal cavity and the little pouch of peritoneum about the fistula is stripped from the dome of the bladder with the finger in the peritoneal cavity as a guide. The peritoneum is then closed without drainage, the whole fistula excised and the prostate removed as usual. This leaves a clean wound for suture.

The other alternative is to incise the scar without excising it. Incisions to the bladder downward and outward from the fistula will sometimes enlarge it enough to permit the prostatic lobes to be removed. This seemingly simple operation can cause troublesome hemorrhage deep in the wound, does not entirely guarantee the integrity of the peritoneum, often leaves a slowly healing fistula and is therefore by no means to be commended to the inexperienced.

After the prostate is out, if the recti have been separated sufficiently to threaten hernia, their edges should be freed from scar and brought together with a separate line of suture for muscle and for the anterior sheath. It is customary to suture the bladder wall above the fistula to the lowest point of suture in the recti.

Complications during the Operation.—The most important complication likely to be encountered during the operation is the presence of some unsuspected condition either in the prostate itself, such as a sclerosis, cyst, calculi, abscess or carcinoma, or in the bladder, such as tumor, stone or diverticulum.

Cyst and abscess of the prostate are very readily attended to by breaking them widely open. The large cysts seem to have no tendency to recur. Bladder stones are readily removed and scarcely constitute a complication unless very large. Bladder tumor, if of low malignancy, is to be destroyed by the most effi-

cient cautery available and the patient cystoscoped as soon after operation as possible to note the result. One may implant radium emanation seeds through the McCarthy panendoscope before the suprapubic wound has healed.

If an extensive infiltrating carcinoma is discovered after the bladder is opened, the prostate had better not be removed but operation deferred until radium can be obtained and a week after the implantation of this, prostatectomy may be performed.

The operation for diverticulum may be combined with that of prostatectomy but if the diverticulum is of any great size, it is wiser first to remove the prostate and after the patient has convalesced from this, to remove the diverticulum.

The operations for stone, sclerosis, carcinoma of the prostate are described elsewhere.

Difficulty may be encountered in (1) tearing through the urethral mucosa, (2) finding the line of cleavage, (3) extracting the lobes from the urethra or from the bladder, (4) controlling hemorrhage.

1. If the prostate has been much inflamed or a urethral catheter has been worn for some time, the urethral mucosa may be so thickened that it is all but impossible to break through it. If the operation is being performed under direct vision, a stroke of the scalpel will solve this difficulty; if by palpation, the blade of the knife must be pressed firmly into the index finger, both together introduced into the prostatic urethra and the mucosa deeply incised above the lobe on each side.

But if the obstruction is purely sclerotic and one or both of the lateral lobes are not at all enlarged, no enucleation of such a lobe is possible.

2. A prostatic obstruction that is predominantly sclerotic may still have slight enlargements of the lateral lobe that must be removed as best one may, in spite of the fact that the line of cleavage is all but obliterated.

3. When the mucosa is very dense, it may be quite difficult to tear the lateral lobes from the apex of the prostate. After these lobes have been thoroughly enucleated, the fingers may be withdrawn from the rectum, the lobe grasped with a sponge stick or a special lobe forceps and its narrow mucous membrane attachment divided with scissors as near the verumontanum as possible.

Lobes loose in the bladder are quite elusive if one is operating by touch alone. They are to be located by the index finger and extracted by a sponge stick or lobe forceps.

4. Of the innumerable devices that have been employed to control hemorrhage, but three have survived: Suture, pressure and drainage.

Suture of the bladder neck sounds well but is not particularly effective. No method has been devised for closing the wound tight. The friable urethral mucosa will not hold a suture and although from the spectators' point of view a suture of the bladder neck looks well, a finger in the prostatic cavity will reveal raw surfaces. It is not improbable that much of the capillary hemorrhage naturally ceases while the suture is being introduced. Even arterial spurters can be as well controlled by the bag pressure as described above.

As to the choice of method whereby pressure is to be applied, the bag is certainly the easiest to apply, to loosen, to reapply when necessary, is far less painful on removal than any gauze packing. Hemostatics in gauze are without value.

The third principle, that of drainage, is, thanks to the influence of Freyer, much more respected in Europe than in this country. The principle employed by him was that of supplying a drainage so free that no matter how much the prostate bleeds, this blood will escape and the bleeding will finally cease. This escape he provided by means of a tube so large that a sponge forceps could be introduced into the bladder through it and thereby pluck out the blood-clots which might plug it up, and thus excite bladder spasm and further bleeding. This tube, with a small inflow tube on one side of it for continuous irrigation to prevent the formation of clots in the bladder, is sold as Marion's tube and is depended upon by many surgeons to control prostatic hemorrhage without any packing in the prostatic bed. I have employed this method upon many cases and have found that most of them could support the loss of blood perfectly well. Yet, the bag packing prevents most of the hemorrhage without grave inconvenience to the patient on condition that the bag pressure is removed early.

Prostatectomy for Sclerosis and Prostatic Calculi

The removal of the prostate for sclerosis or for prostatic calculi will be done by the same operative technic except that many patients with prostatic calculi or sclerosis do not require treatment at all and many cases of prostatic sclerosis can be relieved by the intra-urethral attack.

I prefer the suprapubic approach with exposure by Trendelenburg position, automatic retractor and illumination. The mucous membrane is then cut in a

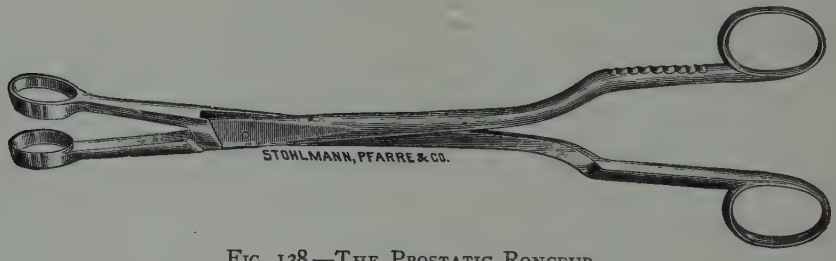

Fig. 138.—The Prostatic Rongeur.

crescentic fold at the vesico-urethral junction over the tightest part of the constriction at the floor and sides of the urethra. The mucous membrane of the bladder is then elevated by blunt dissection for about 2 cm. so as to permit destruction of the scarred prostate with as little sacrifice of bladder mucosa as possible. Two fingers are then inserted into the rectum and with a large rongeur forceps (Fig. 138), with one blade inserted into the urethra and the other in the bladder but beneath the elevated mucosa, a bite is taken in the floor of the urethra. This one bite, which removes a piece about as large as the little finger nail and of

the thickness of the bladder neck, widely opens the bladder neck, but if a finger is then introduced and the bladder neck palpated against the finger in the rectum, hard masses of scar will be felt either in the mid-line or to one or both sides. These must be removed by secondary bites until all the tissue between the finger in the urethra and that in the rectum feels soft. The urethra is then carefully palpated for slightly enlarged lateral lobes and these are extracted.

The Pilcher bag is then introduced and the operation concluded like a prostatectomy.

Variations.—The operation can be done by means of the Young punch depressed against a finger in the rectum by one in the suprapubic wound. The present fashion is to attack these obstructions by the Collings or the Caulk cautery through the urethra.

Prostatectomy for Calculi.—The operation is conducted like that for sclerosis either with the Young punch or some form of rongeur. Slight enlargements of the lateral lobes are usually found and in the enucleation of these the little birdseed stones are encountered in the line of cleavage. If great care is taken to remove all the enlarged prostatic tissue, it will usually be found that no more stones can be palpated between the finger in the rectum and the finger in the urethra. But if the lobes are not at all enlarged, the stones embedded in the thin layer of prostatic lobe are extracted with the greatest difficulty. Stones near the apex of the prostate are especially likely to be overlooked.

Those operators who prefer the perineal approach employ the technic of Young or some modification of it.

Prostatectomy for Carcinoma

When in the process of enucleating an enlarged prostatic lobe the finger encounters an adherent, dense, scarlike tissue in the depth of the prostate near the bladder neck, carcinoma may be suspected, and when in the course of an attempt to enucleate a sclerotic lateral lobe the specimen comes to the surface with a fragment of seminal vesicle forming part of it, the diagnosis of carcinoma is established. Under these circumstances the best one can do is to free the urethra as much as possible and submit the patient immediately thereafter to deep x-ray treatment.

Deliberate extirpation of prostatic carcinoma requires removal of the whole prostate together with its capsule. This operation was first performed by Leisrink in 1882, a similar operation was performed by Fuller in 1898, and the technic has been finally perfected by Young (1904).

Instruments Required.—The instruments required are practically the same as those used in extra-urethral prostatectomy.

The Operation.—The patient is put in the extreme lithotomy position, and the prostate exposed as for extra-urethral prostatectomy. But the separation of the rectum from the prostate should be carried not only to the upper end of that gland, but over the seminal vesicles as well. After these structures have

been thoroughly freed, the incision is made in the membranous urethra and Young's tractor introduced into the bladder and opened. The handle of the tractor is then depressed and the membranous urethra divided above it transversely close to the apex of the prostate.

"By further depressing the handle of the tractor, the puboprostatic ligament is exposed and easily divided by scissors, thus completely separating the prostate from all important attachments (except posteriorly). The lateral attachments, which are slight, are easily separated by the finger. The posterior surface of the seminal vesicles is then freed by blunt dissection, the now mobile prostate being drawn well out of the wound" (Young).

The mass is then drawn strongly downward and the neck of the bladder is incised in the middle line in front, and about 1 cm. above the prostate. The incision in the bladder wall is continued down on each side until the trigone is exposed. The ureters are searched for and the line of incision carried across the trigone so as to pass 1 cm. in front of the ureter orifices. By blunt dissection the base of the bladder is then pushed upward from the anterior surface of the seminal vesicles and vasa deferentia. These are then freed from the bladder, leaving as much of the fat and areolar tissue attached to the vesicles as is possible. The vasa deferentia are drawn down by a blunt hook and divided as high up as possible, care being taken not to damage the ureters. The seminal vesicles then come down more easily. Their upper ends are ligated and the whole mass removed.

Reconstruction of the vesico-urethral gap is now necessary. The stump of the membranous urethra is identified by the passage of a catheter from the meatus. The bladder, which has retracted far up into the pelvis, is caught with forceps and drawn down again.

"The first suture is placed by inserting the needle through the triangular ligament above the urethra, and then out through the anterior wall of the membranous urethra, then through the anterior wall of the bladder in the median line from within out, care being taken to include only the submucosa and the muscle. This leaves the knot outside the junction of the two approximated edges. The thread is left long. Lateral sutures, including the periurethral muscular structures below, and two posterior sutures, complete the anastomosis of the membranous urethra with a small ring into which the anterior portion of the margin of the vesical wound has been fashioned by tying the sutures. The remainder of the vesical wound is now closed with sutures" (Young).

Young drains the bladder at the point of junction of urethra and bladder. The levators are brought together as after perineal prostatectomy for prostatism.

Suprapubic Route.—Suprapubic attack upon the carcinomatous prostate should be a mixture of surgery and radium implantation. It is employed with the object of relieving retention of urine while despairing of curing a carcinoma.

In as much as the carcinoma obstructs the whole length of the urethra, the obstructing mass of prostatic tissue will be found quite different from the ring of scar at the bladder neck which characterizes sclerosis of the prostate. Carci-

noma contracts the whole length of the prostatic urethra and in order to relieve obstruction, one must dig out all of this tissue with rongeur forceps or Young's punch, scalpel and scissors. When the soft tissues beyond the growth have been reached, it is my custom to implant about twenty 1.5 mc. gold seeds of radium emanation.

Radium.—Very early cases of prostatic carcinoma may sometimes be controlled by exposing the prostate through the perineum in the usual manner and implanting radium seeds in it and in the vesicular region as well, one seed to each corner of each cubic centimeter to be irradiated.

After Treatment

The management of the bag has been described.

As soon as the patient arrives in his bed, he is given a hypodermoclysis of 500 c.c. of saline solution. An hour or two later the bag is removed and an indwelling catheter left in the urethra, introduced by suturing it to the tail of the bag tube or by means of a Guyon obturator. I employ no suprapubic drainage after prostatectomy, except to keep the recti apart. A well trained nurse will keep the urethral catheter working by means of repeated irrigation with any mild antiseptic solution that the surgeon prefers. Silver nitrate 1 : 10,000 is the best. Indeed at St. Peter's this is used as a continuous irrigation in 1 : 20,000 strength. The amount of irrigation actually required by the bladder varies considerably. I have seen cases get perfectly well and pass absolutely clear urine following a prostatectomy after which no irrigation had been used at all. One prefers to wash the bladder daily and to vary the solution and the frequency of its use in accordance with the sensitiveness of the patient and the degree of infection present.

After the first hypodermoclysis, water is pushed by mouth and it is rarely necessary to combat grave renal deficiency. But if the tongue becomes dry, the patient delirious, the stomach rebellious, these symptoms of renal insufficiency are attacked by restriction of diet, forcing fluids, hypodermoclysis or intravenous saline twice a day, Murphy rectal drip, and for the most severe cases, feeding and forcing of fluids by the duodenal tube.

Secondary hemorrhage may require emptying the bladder of clots and an emergency blood transfusion. Such hemorrhage may occur at any time during the convalescence up to the third week. Pulmonary embolus may carry off the patient unexpectedly at any time between the second and the twenty-fifth day. It is no more common after prostatectomy than after any other operation upon the pelvis.

If the urethral catheter works well, the suprapubic wound will remain clean and the nurse will find as he irrigates the bladder each day that the bladder begins to hold as much as three or four ounces without spilling over through the suprapubic wound. At this time the urethral catheter may be removed, a suprapubic cup placed over the wound in the abdomen and no further bladder irriga-

tions performed. But I prefer to keep the catheter in until the suprapubic wound is apparently quite healed.

I have used a simple and efficient suction apparatus attached to suprapubic drainage to keep the patient clean after prostatectomy. In Bellevue Hospital where special nurses were not available, the apparatus was extremely useful. It does not compete with a good nurse and an indwelling catheter.

Postoperative Complications.—The more familiar inflammatory postoperative complications are acute epididymitis or acute pyelonephritis which may result in pyonephrosis, pelvic abscess, bladder stone and continued frequency of urination with a contracted violently inflamed bladder in spite of the relief of retention, or, more commonly, simply a continued pyuria without subjective symptoms. Secondary hemorrhage may also occur and hernia of the abdominal wall may result from the operation. Some of these complications, such as epididymitis, pyelonephritis, pyonephrosis, are not influenced in their diagnosis or treatment by the fact that they have followed an operation.

A rise of temperature following prostatectomy may be due to an inflammation beginning in the epididymis, in the kidney parenchyma, in the pelvic cellular tissue or in the lung, or it may be due to retention from clots in the bladder or to intestinal stasis. If the bladder wound has been sutured tight around the tube, retention in the bladder is a possible cause of fever but with the method of operation described, the daily irrigation through the urethral catheter eliminates the bladder as a source of infection.

Among the other specified sources the pelvic cellular tissue is one always to be borne in mind. The finger may have torn through the prostate and so opened the deeper pelvic planes to infection or else the dome of the bladder may have been carelessly stripped from the pubes, thus opening the higher plane. In either case, bimanual examination will reveal infiltration and tenderness behind the bladder, above the prostate or deep tenderness in one side or the other of the pelvis. This complication is to be treated by anesthetizing the patient, reopening the abdominal wound and dissecting the bladder free from the lateral pelvic wall on the side affected. If the case is seen late, the abscess will point in the ischiorectal fossa, in the abdominal wound or in the lower part of the loin like a perinephritic abscess, indeed it becomes paranephritic.

Stone in the bladder following retention occasions a stormy convalescence. The bladder spasms continue after operation or recur after a few quiet days and the presence of the stone is usually not disclosed by x-ray. The cystoscope sees it and litholapaxy takes care of it.

Pyuria following prostatectomy may be attributed to the unhealed prostatic cavity for the first month or two. Continued pyuria after that time may be neglected if the patient is old and feeble and empties his bladder and one despairs of making him much better, otherwise the source of the pyuria should be diagnosed by cystoscope, etc., quite as though the patient had not been operated upon.

A most trying situation is presented by those patients who continue to suffer from grave frequency of urination in spite of relief of retention and absence of

stone or tuberculosis. The frequency of urination often recurs several months after the prostate has been removed and may then continue indefinitely. Figure 45 is a cystogram taken of such a case. The precise cause for this condition is not clear. It has been attributed to vesiculitis; and Sir John Thompson-Walker's operation of vesiculectomy was devised to relieve the spasm of this class of patients. They actually suffer from pericystitis as well as an intense cystitis and are not helped by suprapubic drainage alone. I have not performed vesiculectomy for the relief of the condition but have got the better of it by antispasmodic decompression.

Secondary hemorrhage, if it occurs before the suprapubic fistula has closed, should be treated by reopening this, applying a Pilcher bag for two hours and meanwhile performing a transfusion. These steps should be taken without delay, for once the patient bleeds enough to pass clots, he is almost certain to continue passing them until he gets his transfusion.

If the hemorrhage occurs after the suprapubic fistula has closed, the bladder should first be emptied by the washing bottle and litholapaxy tube while preparations are being made for operation. The suprapubic wound is then reopened, the Pilcher bag applied, the transfusion performed. Hemorrhage is not fatal, if thus promptly attended to.

Other vascular complications, such as thrombosis of the pelvic veins, causing prolonged fever, with pelvic aches and pains and leading to emboli, occur much as they do after any other surgical operation and the various cardiac complications of prostatectomy are those common to old men.

Hernia is very likely to follow a two stage prostatectomy and is not uncommon after the one-stage operation. Yet it is by no means inevitable. I have recently done my sixth suprapubic section upon one of my patients who, with a spina bifida and paralyzed bladder has never been able to keep his bladder clean of stone. He has had no hernia after any of these operations and is apparently sound now.

Most of the postprostatectomy patients are so old and feeble that a belt is all they require. But if the patient has to be operated upon a second time, one should take the occasion to excise the hernial sac and suture the bladder to the abdominal wall above the point of bladder drainage so as to prevent recurrence. If the posterior sheath of the rectus can be found, this may be sutured to the bladder in the mid-line. Large hernial openings may have to be closed by transplant of fascia lata beneath the recti. If a transplant is done, the bladder may not be opened until the graft has taken.

Persistent Retention of Urine.—Unless the removal of the prostate results in relief of retention the operation is a failure. The statisticians have learned this and no longer report patients with persistent residual urine as "improved," for the patient's essential condition is then unrelieved, symptoms continue, kidney damage progresses.

The prompt disappearance of pus from the urine is the best evidence that the retention has been relieved. But if this sign is lacking, the catheter must

be passed at frequent intervals to flush out the prostatic cavity and bladder and also to measure residuum.

Within a month of operation we may still hope that the passage of a sound once a week will iron out the scar and permit the bladder to empty. If this fails, the cystoscope will show one of four conditions; viz., an unsuspected diverticulum, an unremoved lobe, a bar or sclerosis at the bladder neck or an obstructing tab of mucous membrane. A spinal tap will prove the presence of tabes.

The treatment of such conditions is the same as though they had occurred independently of prostatectomy. Scar at the bladder neck may be attacked by the Caulk or the Collings operation.

Recurrence of retention at a long interval after prostatectomy may be due to sclerosis or to renewed growth of prostatic tissue that had not undergone hyperplasia when the operation was performed.

URETHRAL OPERATIONS

Bottini was the first to attempt removal of the prostatic obstacle by dividing it with an electrocautery knife. His operation had an enormous vogue for a time until Freudenberg reported that almost all of the cases that had been reported as relieved had actually relapsed.

I operated upon seventy-five cases by the Chetwood operation (Bottini performed through a perineal incision) and ten years later found that almost all had relapsed.

Young has given us a urethral punch wherewith to bite out pieces of bladder neck and continues to perform this operation undismayed by the profuse hemorrhage that often results. Most operators who attack the sclerotic prostate with the Young punch do a preliminary cystotomy through which they can guide the bite of the punch and drain the bladder afterwards to take care of the hemorrhage.

Caulk has devised an ingenious electrical cautery punch with which, as the years go by, he attacks more and more extensive obstructions of a lateral lobe and middle lobe type, entirely disregarding Young's opinion that the punch operation is not suited to the removal of any obstructions of the adenomatoid type. Caulk even contends that among the advantages of his operation are the possibility of several times repeating it upon the same patient and that the secondary effect of the operation, when it has bitten off a piece of a large lobe, is to encourage the shrinking of the remainder of that lobe.

Collings employs a radiotherm (high frequency) knife to burn a groove in the neck of the bladder of sufficient depth to relieve sclerotic obstruction. He does not operate upon enlargements of the prostate.

It is impossible to accumulate sufficient experience to judge fairly between so many claimants. The conditions found when a sclerotic prostate is examined through a suprapubic wound, lead one to doubt the general advisability of de-

pending upon an operation which does not permit digital proof of the presence or absence of slightly enlarged intra-urethral lateral lobes which are so often overlooked by any preoperative examination. One also finds it difficult to believe that any intra-urethral operation, without the benefit of palpation within the bladder, can satisfactorily divide the deeper layers of scar which doubtless must be divided if the cure is to persist. One would suppose that the Bottini and Chetwood operations divided the bladder neck rather more deeply than do any of their successors, and yet patients thus operated upon suffered recurrence of retention in five or ten years.

But against this we may set the fact that even the most radical suprapubic operation, short of complete extirpation of the prostate as for carcinoma, leaves some scar at the bladder neck and does not guarantee the patient that this scar

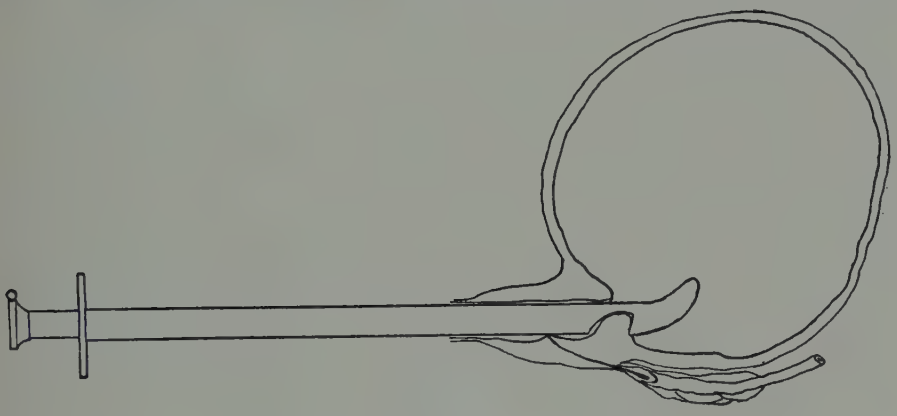

Fig. 139.—Young's Prostatic Punch.

will not ultimately relapse. And we have further to deal with that unknown quantity—the relative capacity of the bladder muscle to overcome a given urethral obstacle. Occasionally the urethroscope or even the cystoscope cannot be introduced into a bladder because its neck is so rigid, yet this sclerotic prostate may have occasioned no symptoms and caused no retention of urine. And finally, it is to be remembered that in many instances a temporary relief of urethral obstruction is all that is demanded, and although I happen never to have lost a patient operated upon for prostatic sclerosis, the dangers and discomforts of the urethral operation are manifestly less than those of the suprapubic operation unless the urethral operation goes wrong. There have been deaths following the Bottini operation from infiltration of urine in the perineum or behind the bladder. There have been deaths following the Young operation from biting a fold of bladder by mistake for the bladder neck and from hemorrhage into the bladder. The Caulk instrument is fragile and has been known to unwind its cautery blade and perform unpleasant internal urethrotomies as this blade was being extracted. I have not yet heard of any accidents peculiar to the Collings operation and therefore, for the moment, prefer it, though in order to

be successful it must be performed by a very patient surgeon who will again and again run the cautery knife to and fro over the neck of the bladder so as to destroy it to a sufficient depth to be worth while.

Collings Operation.[1]—The instruments required are a McCarthy panendoscope, a Collings cautery knife and Wappler's electronome generator. Caudal anesthesia is sufficient.

With the patient in cystoscopic position, the panendoscope is introduced into the bladder. The cautery knife is so adjusted that its blade is plainly seen. The instrument is then withdrawn until the bladder neck, at "six o'clock," comes into view. The current is then turned on very gently until contact of the knife with the mucosa burns this with the liberation of bubbles. The cautery is brought against the mucosa for a moment and immediately withdrawn so that it never presses into the tissues, never sticks to them, never slips over the bar into the urethra so as to be extricated with difficulty.

Meanwhile the current is turned on more and more until the bubbling is furious. In order to keep the field clear of bubbles a slight current of fluid is kept running all the time. As this fills the bladder, the operation is discontinued from time to time, the telescope withdrawn to empty it, reintroduced, and the burning resumed and continued as though the bladder neck was never going to be burned through, the repeated touches of the instrument are so light. After fifteen to twenty minutes of this patient, apparently superficial, cauterization the floor of the urethra comes into view. Then the cautery is run to and fro along the whole length of the groove that has been cut in the bladder neck until the trigone and bladder neck seem on a level. Then the groove is widened by turning the cautery first to one side and then to the other, burning lightly as before until the floor of the groove seems about 5 mm. wide.

A catheter is then tied in the urethra, the bladder washed with silver solution until this returns clear; then the patient is sent to his bed. The catheter remains in for forty-eight hours. Thereafter the patient should empty his bladder.

PERINEAL PROSTATECTOMY

The patient is put in Halstead's so-called "exaggerated lithotomy position," the buttocks elevated by tilting up a flap at the foot of the operating table until the perineum is practically a horizontal plane—the legs being so fixed by lithotomy supports that both hips and knees are forcibly flexed, the knees resting upon the abdomen.

The special instruments required for Young's operation are his four retractors, forceps for clamping the prostatic lobes, enucleator, and vesical tractor, also a sound, a staff, and a sharp-pointed bistoury. A sound is introduced into the urethra as a guide.

The operation may be performed through a curved prerectal section running from one ischial tuberosity to the other, and passing about 3 cm. in front of the

[1] *J. Urol.*, 1926, xvi, 545.

anus (Proust); or one may make two lateral converging incisions and connect them in front by a snip of the scissors (Young).

After incision of the skin and fascia the flap is drawn back and a finger pushed into the loose cellular tissue on either side of the bulb. This blunt dissection must be made behind the transverse perineal muscles. The bulb of the urethra, surrounded by its muscles, is then fully exposed and the central perineal tendon divided with scissors immediately beneath it. Young's bifid retractor is then introduced posteriorly and strong traction made while the bulb of the urethra is held up and carefully dissected free.

It is most important in this, and the succeeding steps of the operation, to stick close to the urethra, feeling one's way on the sound in that canal. As soon as the most dependent portion of the bulb, identified by its median raphé, has been freed, *the line of incision turns at a right angle* to strike for the membranous urethra.

Division of the Recto-Urethralis.[2]—"Immediately beneath the deeper portions of the central tendon, which runs between the rectum and the posterior part of the bulb, one finds the recto-urethralis muscle, a small amount of fascia usually overlying it. Incising cautiously through this fascia and the muscle beneath, close to the posterior part of the bulb, the longitudinal fibers of the recto-urethralis are finally divided completely, thus liberating the rectum which is retracted and pushed with the handle of the scalpel progressively backward until the membranous urethra is exposed and one approaches the apex of the prostate. In the depth of the wound lie the two layers of Denonvilliers' fascia, the anterior attachment of which is to the membranous urethra and triangular ligament on each side. It is necessary to cut through the posterior layer of this fascia before the prostate can be reached. If this is not done, the blunt dissection may lead one into the rectum. Rectal injuries are almost always due to failure to recognize this fact.

"Having divided the posterior layer of this fascia where it covers the membranous urethra, it is possible to push it backward and expose the apex of the prostate for a short distance in the median line. We, then, usually find exposed to view about ½ inch (1½ cm.) of the membranous urethra, entirely without sphincteric muscles, which have been drawn forward by the encircling bifid bulb retractor."

Exposure of Apex of Prostate and Urethrotomy.—"Just behind the membranous urethra the apex of the prostate is seen and the scalpel is plunged through it upon the sound in the urethra, and then carried forward a short distance along the membranous urethra. The urethral sound will then be visible and upon this the edges of the membranous urethra are picked up on each side with Allis clamps. It is essential that the mucosa should be retracted and a good view of the sound within the urethra obtained.

Prostatectomy.—"*Insertion of Tractor.*—The sound is then withdrawn and a slightly curved sound introduced through the urethrotomy wound into

[2] Young, *Practice of Urology*, ii, 415 *et seq.*

the bladder to make sure that the passageway is clear, after which our prostatic tractor, closed, is introduced Owing to the rather rectangular curve of this instrument, it is best to hold it first with the beak turned downward and the shaft running obliquely until the closed blades are well within the urethrotomy wound. The assistant then removes the anterior bifid bulb retractor and the

FIG. 140.—PERINEAL PROSTATECTOMY.

Division of the left lateral wall of the urethra with scalpel. This is carried out also on the right side, thus making it possible to draw down the triangular flap with forceps and expose the floor of the urethra and ejaculatory ducts, as shown in inset, *a*, in which the urethra is divided on each side, the fold carried downward, and the lateral adenomata exposed. (Young)

handle of the tractor is swung around until it lies against the anterior angle of the wound, while at the same time the instrument is carefully pushed into the bladder and opened out by turning the external handles.

"Exposure of the Posterior Surface of the Prostate.—Making traction, the prostate is drawn well up into the wound, but it is still covered by the posterior layer of Denonvilliers' fascia and the deeper portions of the levator ani muscle on each side (levator prostatæ). The rectum is quite close in the median line,

and it is therefore best to incise carefully upon the apex of the prostate on each side. As the knife passes through the fibers of the posterior layer of fascia (the tissues being pushed back with the handle of the scalpel while so doing) the shiny surface of the anterior layer of Denonvilliers' fascia will be recognized. This fascia forms the real capsular covering of the prostate and, by keeping it in view, and pushing the posterior layer of fascia backward with the handle of the scalpel, a space between them ('l'éspace décollable rétroprostatique' of Proust) will be opened up and an excellent view of the posterior surface of the prostate obtained. In the deeper part of this blunt dissection, use may be made

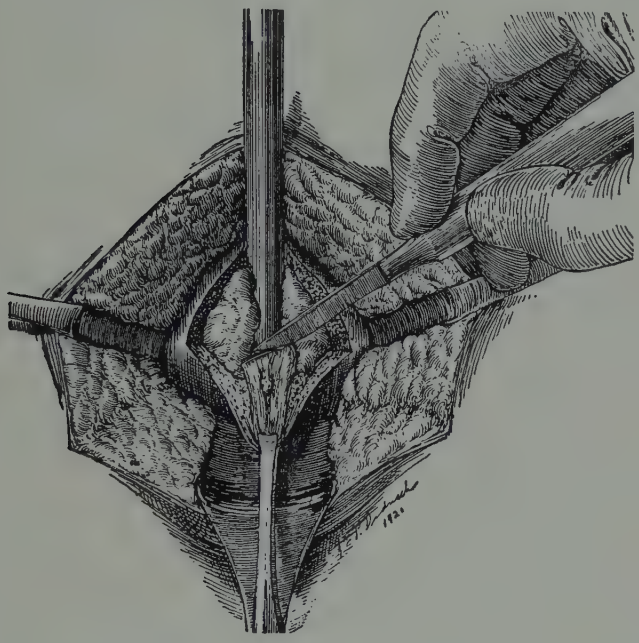

FIG. 141.—PERINEAL PROSTATECTOMY.

The urethra, covering the median portion of the prostate, is here divided transversely with scalpel previous to enucleation. (Young)

of the finger; but care must be taken to work upon the posterior surface of the prostate and not to push too forcibly against the rectum, although it is protected by the posterior layer of Denonvilliers' fascia.

"Having thus exposed the prostate, the levator ani muscles are forcibly stretched on each side and a blunt retractor (without lip) is introduced in the median line or (preferably) two long slender retractors are inserted in each postero-lateral corner and give an excellent view of the prostate. . . .

"Through the inverted 'V' capsular incision, the operation is done as follows: The prostate being drawn well up into the wound, an incision is made on one side, beginning at the posterior angle of the urethrotomy wound at the apex

of the prostate, and extending obliquely backward toward the base of the prostate, for a distance from 2 to 4 cm., according to the enlargement of the prostate. A similar incision is made on the opposite side. These are carried quickly through the substance of the posterior lobe until the urethra is reached on each side. This liberates a triangular flap of prostate and posterior urethra, in the center of which the verumontanum can be easily seen. The next step is to divide the lateral wall of the prostatic urethra longitudinally on each side until the region of the middle lobe is reached.

"Enucleation of the Hypertrophied Lobes.—Making traction upon the prostate, one is able to see by careful inspection of the incision, on each side, a layer of prostatic tissue surrounding the encapsulated hypertrophied lobe. By inserting a blunt dissector at this point one can quickly separate the two and begin the enucleation of the lobe. By to-and-fro motion this is carried quickly backward until considerable depth is reached and the lobe freed from its attachments externally, in front, posteriorly, and from the floor of the urethra. Care should be taken not to injure the ejaculatory ducts. The same procedure is carried out on the opposite side.

"The index-finger of the right hand is then introduced into the cavity between the prostate and the adenoma on the left side and carried by blunt dissection downward, while traction is made with the left hand upon the shaft of the instrument. As the adhesions are broken down and the hypertrophied lobe freed, the operator will soon feel, through the wall of the bladder, the blade of the prostatic tractor. If the lobe projects into the bladder, it may be drawn out by traction through the sphincter into the lateral cavity and its deeper attachments partly freed.

"Changing hands, the operator then attacks the right lobe of the prostate with the finger of the left hand, at the same time making traction upon the instrument with the right hand. The right lobe is then freed from the vesical mucosa, the only attachment being with the mucous membrane as it passes from the bladder into the urethra where it is attached to the inner surface of the lateral lobes.

"The median lobe now remains to be freed. To accomplish this one blade of the tractor is turned downward and traction made by an assistant. The index finger of the left hand is then inserted along the posterior urethra until the tip rests against the anterior surface of the middle lobe. Backward pressure is then made, thus pushing the verumontanum and ejaculatory ducts out of the way, while the blade of a scalpel is inserted along the dorsum of the finger until the middle lobe is reached, when the mucous membrane covering it is divided transversely with the knife near its posterior surface. One is careful to keep close to the hypertrophied middle lobe and not to injure the ejaculatory ducts, which are carried backward in this blunt dissection.

"The object of these divisions of the mucous membrane covering the lateral and middle lobes is to enable the operator to enucleate the hypertrophied prostate in one piece from in front of the ejaculatory ducts. (The same occurs when

the prostatic lobes are enucleated intra-urethrally through suprapubic prostatectomy, only much more mucous membrane is then removed.) Sweeping the finger from side to side and continuing the traction upon the middle lobe, the whole adenomatous prostate is drawn outward and the median and lateral lobes freed, gradually, from the cone of mucous membrane which forms their urethral covering.

"It may be well, here, to grasp the lobes with lobe forceps or Allis clamps in order to facilitate their withdrawal while the mucous membrane is slowly stripped from their inner surfaces from behind. In this final separation a long tube of mucous membrane is freed. Inspection of each side of this will frequently show an artery (inferior vesical) which may be clamped and ligated. If the cone of the urethral mucosa is quite long, it is desirable to clamp the mucous membrane and cut it off with scissors on each side. The hypertrophied lobes, completely freed from attachments and mucous membrane, are then removed, generally in one piece. Sometimes a subtrigonal lobule is present. It should be looked for and removed along with the rest of the median lobe. . . . The sphincter is usually dilated and within it lies a tube of mucous membrane which has been grasped on each side, in front, and behind with Allis clamps by which it is held forward.

"**Examination of the Bladder.**—After removal of the lateral and median lobes the index finger of the right hand is then inserted through the vesical sphincter for careful palpation. It is well to search on each side to see whether there be any remaining lobule. Another finger within the prostatic cavity may assist in a bidigital inspection. The condition of the vesical sphincter is noted; if extremely tight, it should be dilated; if very fibrous, it may be divided posteriorly or a piece removed from it with a 'punch.' The operator should be careful to see that there is no subtrigonal prostatic and no anterior lobule which has escaped detection. The lower portion of the bladder may be palpated with the finger.

"**Removal of Calculi.**—A stone scoop is then introduced to be sure that there is no calculus in the depths of the bladder which had not been observed cystoscopically. If one is found, it is promptly removed through the wound. If very large, it may be necessary to dilate considerably or even to divide the vesical sphincter. In the latter case, it may be desirable to take a few stitches in the divided sphincter. We have frequently done this, but do not believe it essential. We have removed calculi through the perineum 2½ inches (6 cm.) in diameter without much difficulty and in one instance detected and removed a calculus which projected from the orifice of the ureter. . . . The Davis bag is introduced into the bladder with a curved stone forceps. Sometimes it may be more easily introduced by first dilating the vesical sphincter with his special four-pronged dilator. The tube for drainage and the traction tape emerge from the perineal wound. With these no gauze pack is used, and we are generally able to approximate partly the inverted 'V' capsular incision on one side. As soon as the Davis bag is in place it should be blown up with water (we use a

bulb syringe and insert some 50 or 60 c.c.). Traction is then made upon the tape, so as to draw the vesical neck outward and stop hemorrhage, and the bladder is washed clean of clots through the central drainage-tube with a large syringe.

"*Approximation of Levator Muscles.*—With a single large plain catgut stitch these muscles are drawn together to their normal position in front of the rectum. This is important as it prevents pressure of the gauze pack upon the rectum and resultant rectal breakdown.

"*Closure of Skin.*—The tubes (and gauze, if used) are brought through one angle of the wound while the skin is approximated on the other side and in front. We usually employ a mattress suture of catgut as a stay-suture at the apex of the skin flap, and apply clips upon the skin elsewhere. The tube is fastened in place by tying the loose ends of the ligature around it. . . .

"Variations.—The prostate is frequently held by adhesions so that it is impossible to draw it toward the perineum, and occasionally the rectum is so firmly fixed to the posterior surface of the prostate that it is advisable, after exposing the apex and introducing the prostatic tractor, to open the prostate with an inverted 'V' incision and begin the enucleation of the hypertrophied lobes without exposing the posterior surface of the prostate. As a matter of fact, it is not at all necessary to strip the rectum from the posterior surface of more than the apex of the prostate, as it is quite easy to enucleate the adenoma through an inverted 'V' apical incision. . . .

"Occasionally a lobe may become detached and slip back into the bladder. Careful inspection of the specimen should therefore be made to be sure that nothing is missing, and if so, it should be sought first within the prostatic capsule and then within the bladder with stone forceps. In one instance a lobe 1½ inch in diameter escaped us and had to be removed later. . . . Where the prostate is huge, it may be difficult to remove it in one piece. In such cases it is sometimes better to separate the specimen and remove the prostate in two or three separate lobes. The advantage of removing the prostate in one piece is the greater certainty of complete enucleation. . . .

"Postoperative Treatment.—Before leaving the operating room the operator, or his first assistant, should take care to see that hemorrage has been stopped and that the patient is not severely shocked. . . .

"*Removal of Drainage and Packing.*—About six hours after the operation, if the drainage is clear, the traction tapes are released and the bag, thus freed, travels back into the bladder where it is allowed to stay, still distended, for a few hours. Then, no fresh hemorrhage having occurred, a portion of the water distending it is allowed to escape, and on the following morning the bag is completely emptied. A little later the entire apparatus is withdrawn from the wound. In none of the cases in which we have used this apparatus has it been necessary to repack with gauze, nor have we had any pronounced hemorrhages. The introduction of this apparatus has greatly facilitated and safeguarded the immediate convalescence after perineal prostatectomy."

DRAINAGE OF PROSTATIC ABSCESS

Most urologists prefer to drain prostatic abscess by exposing the posterior surface of the prostate through a curved prerectal incision, as for prostatectomy, and draining each lateral lobe into the ischiorectal fossa.

This preference is not justified unless there is periprostatic suppuration. Then it is necessary. But for suppuration confined within the gland, Stevens' operation is ideal.

Under caudal anesthesia and with the patient in the lithotomy position, a 20 F. sound is very gently introduced into the urethra until it reaches the apex of the prostate. With a finger in the rectum the point of the sound is palpated. The sound is introduced just within the prostatic urethra, rotated sharply to one side and, under direct control of the rectal finger, forced into the swollen lobe of the prostate. No attempt is made to dig a large hole in the lateral lobe. The point is withdrawn from the lobe and plunged into the opposite one.

Sound and finger are then withdrawn. As the sound comes out the pus follows. No attempt is made to wash the urethra clean. A catheter is then tied into the urethra and left in for twenty-four hours. No further treatment is given.

This operation has been performed at Bellevue Hospital upon more than one hundred cases. The results are entirely satisfactory. Postoperative epididymitis is rare. If the patient had retention before operation, this is relieved. Sometimes a single postoperative catheterization is required. The sinus in the posterior urethra heals kindly. The subsequent course of prostatitis is not complicated by the operation.

For private practice the operation is a brilliant success. The patient is out of hospital in two or three days.

OPERATIONS UPON THE SEMINAL VESICLES

The same incision as that used by Young for prostatectomy is admirably adapted to operations upon the seminal vesicles. The operation is begun in the manner described above. The rectum should be separated from the urethra not only as far as the prostate, but also beyond it, to reach the seminal vesicle. The section should hug the prostate and vesicle. When the vesicle is reached it may be incised (vesiculotomy) or excised (vesiculectomy). As the wound is very deep the vesicles are brought more fully into view by catching a suture in each of the lateral angles of the prostate and making traction upon this. Young prefers to use his special tractor.

Vesiculotomy.—The vesicles are thoroughly exposed by a transverse incision of the (anterior) fascia of Denonvillier (at the base of the prostate) and split from end to end and their interior curetted.[3] A tube is sutured into this cavity

[3] Cultures were taken from the interior of the terminal vesicle in a few cases operated upon on my service. No growth resulted in almost all.

and led out through the perineal wound, which is closed in the usual manner. This drain is kept in for a week.

Vesiculectomy.—The sheath of the vesicle is split and the organ freed by blunt dissection. It is divided at its entrance into the prostate and extracted after ligature of the artery at its fundus. The vas may be divided and extracted with it; and, if preliminary castration has been done, the whole of the vas may be pulled out through the perineal wound. If the fundus of the vesicle is adherent, its enucleation may be simplified by dividing it as it enters the prostate and endeavoring to shell it out from below upward; but this maneuver may be extremely difficult, and, in as much as the vesicle lies immediately below the peritoneum and is probably adherent to this, rather than risk opening the peritoneal cavity, it may seem wiser to amputate only as much of the vesicle as can readily be freed, and to be satisfied with curetting or cauterizing its remains.

Thompson-Walker has removed the seminal vesicle transvesically by incision through the trigone in the mid-line.

CHAPTER L

INTRAVESICAL OPERATIONS

LITHOLAPAXY

The patient should be given the usual preoperative diuresis. Caudal anesthesia is adequate.

The lithotrite (Fig. 142) is called upon to perform two very different functions—viz., to crush a stone of some size and perhaps of great hardness, and to catch and crush small crumbling fragments that are only just too large for aspiration. For the former purpose a heavy, powerful lithotrite with a fenestrated female blade (Fig. 142) is required, while for the latter I prefer a lighter instrument with a solid female blade of a broad duck-bill shape. A complete outfit should include these and several intermediate varieties of lithotrites, as the surgeon's judgment dictates.

The powerful lithotrite should possess several characteristics: (1) The male blade when screwed home should pass quite through the female blade: an instrument thus constructed cannot become clogged; (2) the wheel (Fig. 143) or globe (Fig. 142) handle of the instrument must be large enough to afford firm purchase for the surgeon's hand; (3) the catch for adjusting the screw action should be sufficiently prominent to be worked without the least difficulty. In my father's instrument, a modification of Réliquet's, the catch is saddle-shaped (Fig. 143). Chismore added to his lithotrite an automatic hammer such as dentists use, and with it claimed to crush the hardest and largest stones with scarcely any effort.

For small, soft fragments a flat-bladed, duck-bill instrument is useful. This instrument should only be employed toward the end of the operation. The non-fenestrated blade has a tendency to clog, but this instrument will, in my hand, pick up fragments that no other lithotrite will catch. For small, hard fragments I employ a light, small-bladed fenestrated instrument.

The evacuator or washing-bottle of Bigelow (Fig. 144) I prefer to any other. The evacuator of Chismore is an excellent instrument. Two evacuators should be carried, lest one fail to work.

Litholapaxy has been restricted by modern surgery to such simple cases that almost any washing-tube is adequate. I have employed Bigelow's, my father's, and Guyon's with equal success.

The Operation.—This is litholapaxy: To catch the stone with an instrument passed through the urethra, to fragment it sufficiently for the detritus to pass out through a tube, and to suck this out by some suitable apparatus.

The patient is placed upon the operating table on his back, with his feet widely separated and a sandbag beneath his hips. He is then catheterized and 100 to 150 c.c. of acriflavin solution injected into the bladder. A lithotrite, selected in accordance with the size of the stone, is then introduced. It may have to be assisted over the prostate by pressure on the perineum.

The surgeon must remember that the specific gravity of the stone is scarcely greater than that of the fluid in which it floats. The least violent move of the lithotrite dislodges the stone; only by the most gentle and deliberate movements can it be grasped.

Once in the bladder the lithotrite is passed gently onward until it touches the wall of the fundus. The male blade is then gently withdrawn until this comes in contact with the anterior wall at the bladder neck, the handle of the instrument is then elevated so that the female blade forms a pouch in the fundus of the bladder. The instrument is thus held for a brief moment, then the male blade is very slowly and gently pushed inward and the stone will usually be found within the grasp of the instrument.

FIG. 142.—BIGELOW LITHOTRITE.

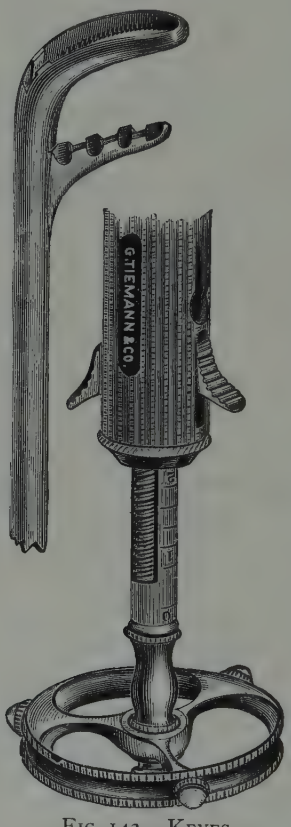

FIG. 143.—KEYES LITHOTRITE.

The screw power is then turned on, the handle given a fraction of a turn to grasp the stone tightly and the whole instrument then withdrawn toward the neck of the bladder to prove that it has not caught any of the mucous membrane in its grasp. If the instrument moves freely, its screw handle is then turned slowly and intermittently until the stone crumbles into fragments. The female blade is then returned to its original position, the male blade withdrawn and the maneuver repeated as often as fragments are thus caught and crushed.

From one to six such crushings are usually required to reduce the stone to small fragments. Then the lithotrite is once again passed to the fundus, and the male blade withdrawn to the bladder neck while the instrument is held ar

before with its blades in the median line. Then it is turned at right angle to the right side and the male blade gently returned toward the female. Small fragments are usually encountered and crushed by this maneuver which is repeated first on one side and then on the other until fragments larger than 1 cm. in diameter are no longer caught. In some instances the last large fragment can only be caught by reversing the blades and closing them with the instrument upside down.

All of these maneuvers must be conducted with the utmost slowness and gentleness.

The lithotrite is then withdrawn and the evacuating tube introduced and attached to the evacuating bottle full of acriflavin solution. With the eye of the

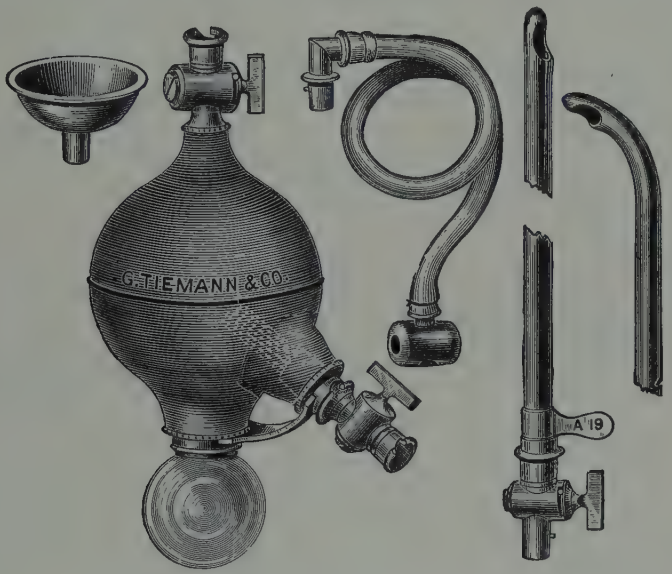

Fig. 144.—Bigelow Aspirator and Washing-Tube.

tube just inside the bladder neck the bulb is given a sharp pinch of sufficient strength to evacuate perhaps one-third of its contents, and immediately released. As the rubber reëxpands the solution rushes from the bladder into the evacuator, carrying with it the fragments of stone which sink into the glass collecting bottle at its bottom. This maneuver is repeated until no more fragments come away, and continued thereafter a few times while the operator notes whether any click against the tube announces the presence of any further fragments in the bladder. If he believes he has exhausted most of the stone, a lithotrite with a solid female blade is introduced and put through the same motions as above described. Whether any fragments are thus caught and crushed or not it is wise once more to evacuate so as to certify the removal of the last fragment. It is then prudent to close the operation by the introduction of a cystoscope whereby the bladder can be visually examined and the absence of stone proven.

The unaccustomed operator may be misled by the click produced when the bladder wall catches in the eye of the tube. This is a muffled double click with a pull to it quite distinct from the single sharp click of a stone fragment. By moving the eye of the instrument to another part of the bladder, contact with its wall is readily avoided.

If there is a tight bladder neck or if the operation has excited much bleeding, a catheter should be tied into the urethra and left there for twenty-four hours, or longer. But in most instances the bleeding within the bladder is very slight and no after treatment is required.

Difficulties.—If the stone cannot be grasped it is doubtless adherent to some part of the bladder wall, and suprapubic section had better be done forthwith. The same resort is open to the surgeon who fails to remove the last fragment or breaks his lithotrite. This accident never happened to my father in 150 operations; it has happened to me once.

I have once seen excessive hemorrhage in the course of a litholapaxy due to the presence of an unsuspected bladder tumor. I have once perforated the bladder of a pregnant woman. Prompt section saved her life. The pregnant uterus spreads the bladder into two lateral pouches which are most unsuitable for litholapaxy.

Success depends entirely upon the surgeon's skill and technic. What is most difficult to the novice is to crush the stone methodically and deliberately. The first catch and crush is usually easy, and perhaps in a given case it would be possible for an unskilled operator to make quick work of the larger fragments without any particular method; but long before the last fragment has been crushed such an operator will find himself pottering about in the bladder, never finding any considerable fragment, although the clicks upon the tube assure him that there is plenty of work left to do. This deadlock may continue quite indefinitely, and the only way to avoid it is to know in exactly what part of the bladder the stone tends to lie and in exactly what part of the bladder the beak of the lithotrite is.

After Treatment.—Diuresis is resumed after operation.

The irritability of the bladder for the first few days may be controlled by narcotics. Nitrate of silver irrigations afford great relief.

It is unwise to let most patients get up before four days have passed. I have in exceptional instances turned my patient out on the second day. I have indeed several times operated in my office under caudal anesthesia—but this again only in exceptional cases.

The after treatment cannot be considered complete until the patient has been cystoscoped for stone one month after the operation, nor can any assurance be given that no fragment has been left behind until this search has been performed.

Postoperative Complications.—After litholapaxy all the complications may occur that are met with after the various operations upon the urinary tract: retention, hemorrhage, urethral fever, cystitis, prostatic abscess, epididymitis,

or even the graver complications, suppression, surgical kidney, even pyemia and septicemia; but the occurrence of such complications indicates that the surgeon's skill does not equal his zeal. I have never lost a patient after litholapaxy.

Relapse after litholapaxy may occur from one of three causes: A fragment may be left by the operator; a new stone may come down from the kidney; or reaccumulation may occur behind an enlarged prostate. The relapse of stone is an indication for lithotomy (and prostatectomy).

HIGH FREQUENCY CAUTERIZATION OF BLADDER LESIONS

Since the introduction of the high frequency current used through the cystoscope as a means of attacking lesions of the bladder and urethra by Beer,[1] this treatment (fulgurization) has been applied, not only as first suggested for the cure of papillomata, but also for the healing of ulcers, the explosion of stones, and the cure of granulomata in the urethra as well as the destruction of obstructions at the bladder neck whether due to simple prostatism or to carcinoma.

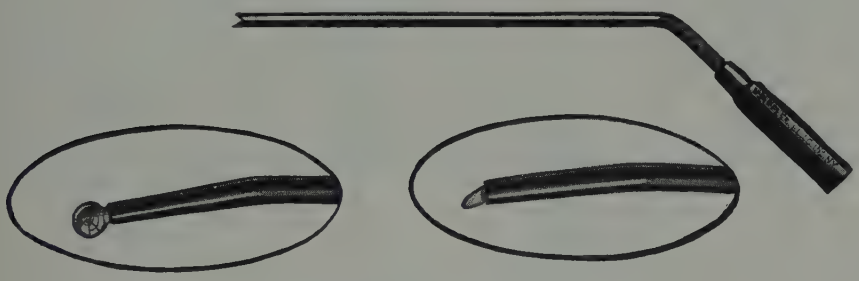

FIG. 145.—FULGURIZATION WIRES.
The globe tip is best for burning the tumor, the knife tip for cutting the pedicle.

Most operators use the bipolar d'Arsonal current. Beer likes the monopolar Oudin. He admits over 20 per cent recurrences. I have of late been using the Wappler "electronome" and hope for less severe hemorrhages as the sloughs separate.

The fulgurization of bladder papillomata requires the following instruments:

A cystoscope, preferably of the so-called operative type; an insulated wire or flexible metal probe, and generator for the high frequency current are needed. Dry cells should be used for the cystoscope in order to avoid short circuit. The cystoscopic and electrical instruments made by Wappler are usually employed. In as much as diagnosis as well as treatment may be part of the operation one also requires a pair of forceps for removing specimens from the neoplasm.

The operation, under caudal anesthesia if the tumor is large or the patient sensitive, is performed as follows:

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[1] *J. Am. M. Ass.*, 1910, liv, 1768.

The patient is cystoscoped in the usual manner. A section of the tumor is removed by the cystoscopic forceps. Forceps and telescope are then withdrawn so as to empty the bladder of the blood which follows the removal of the specimen. The electric wire is then introduced, with the telescope, and plunged into the depths of the tumor. It is then attached to the source of electricity (see below), the current turned on for an instant. If the patient feels any pain, the electrode is touching the bladder wall and should be shifted to the tumor. As soon as the current is turned on, bubbles begin to appear from about the end of the electrode, and the tissues near it become blanched and subsequently black. The electrode is held in place for about thirty seconds, and then moved to another part of the tumor and the operation repeated. The operation is thus continued by repetitious burnings of various portions of the surface of

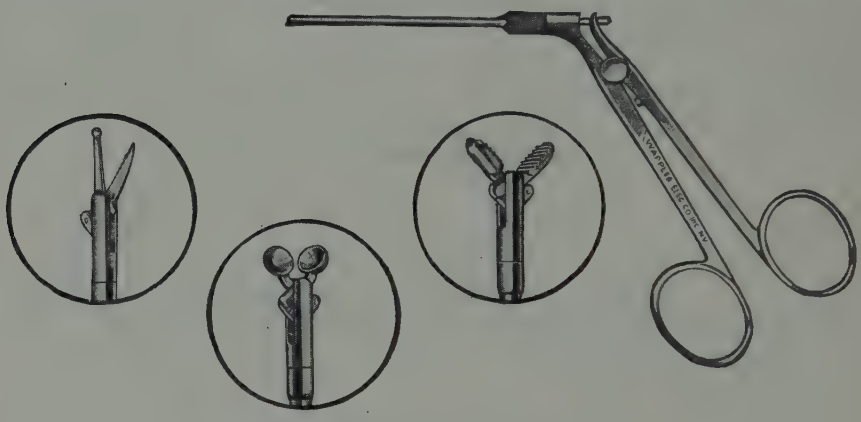

FIG. 146.—CYSTOSCOPIC FORCEPS.

The cup-shaped blade is used for biopsy; the serrated blade to pick up specimens; scissors to cut the ureter mouth—fulgurization of the ureter mouth is preferable.

the tumor until the patience of the operator and of the victim is exhausted, or until the tumor has become completely charred over its surface.

If the tumor is large one should try to attack the base of the tumor by slipping under its overhanging fringes and endeavoring to burn its pedicle, thus once for all destroying its blood supply.

After the operation the patient should rest relatively quiet for twenty-four hours. If the bladder becomes irritated the best injections to employ are silver nitrate and argyrol. At about the tenth day sloughs begin to separate and there is likely to be some bleeding. Exceptionally this bleeding is very grave. I have twice had to empty the patient's bladder of clots by the evacuating tube and several deaths have been reported from hemorrhage. For this reason the patient should be within call of an experienced physician for at least two weeks after each operation.

The operation is repeated every two weeks until the tumor has been appar-

ently burned away. No note need be taken of swelling that appears about the base of the tumor, for such a swelling, though it looks exactly like carcinoma, is due to the burning itself.

After the tumor has been apparently destroyed a month is permitted to elapse, then a confirmatory cystoscopy is done. This confirmation should be repeated after six months, then after a year, and doubtless thereafter at intervals of three years.

Recurrences are extremely uncommon excepting in the outgrowth of small papillary lesions that had been overlooked at the time the first tumor was treated. Only one relapse *in situ* after an interval of more than one year of apparent health has been reported.[2]

Limitations of Fulguration.—In order to realize how limited is the effect of fulguration, the operator should practice the method upon warts. He will find that much burning is required to destroy a small benign papilloma of the skin. The same is true of the bladder. Infiltrating lesions should never be attacked by fulguration. Papillary lesions that are large or multiple respond admirably to fulguration, cauterization, diathermy or radium, implantation through a suprapubic opening. The inexperienced urologist must attack such lesions through the open bladder until he has grown familiar with his capacity to control them through the cystoscope.

Each time the treatment is repeated the operator must note the progress that has been made. Any lesion that resists six treatments is a malignant neoplasm that has been neglected for three months.

CYSTOSCOPIC APPLICATION OF RADIUM

Metal "seeds" containing radium emanation are inserted into the base of the tumor, one at each corner of 1 cm. the insertion is made with flexible applicators supplied with the seeds. Muir's breech-loading model is the most convenient.

Advertising catalogues depict this operation as though large solid tumors could be treated thus. Such is not the case. I have not found it profitable to attempt to implant more than four seeds at one sitting. This means that only tumors with small base may be so treated. Moreover the mobile portion of the bladder where the tumors grow recedes before the pressure of the needle so that it is not easy to place the seeds precisely as one would wish. Confirmatory radiography after implantation shows that at least one in four has fallen out, doubtless because the needle actually slips through the tumor and drops the seed in the bladder behind it. Here again, therefore, the inexpert operator will profitably prefer the suprapubic route for radium implantation.

The implantation almost always requires caudal anesthesia.

The pseudocarcinomatous reaction from radium lasts for months. It must not be mistaken for tumor.

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[2] Two deaths by rupture of the bladder have been reported.

CYSTOSCOPIC FORCEPS

Young was the first to introduce a cystoscopic forceps for the purpose of removing foreign bodies or specimens from growths in the bladder. Buerger has further developed this method and devised a very ingenious set of cystoscopic instruments whereby specimens may be removed from doubtful cases of tumor, tuberculosis or other bladder lesions; foreign bodies and even wee stones may be picked up, though stones are extremely elusive.

The cystoscopic lithotrite has not yet been perfected to a degree permitting its general use.

CYSTOSCOPIC EXTRACTION OF URETER STONES

Operation upon the Ureter Mouth.—To remove stones or to dilate stricture the first requisite is often the division of the strictured ureteral meatus. This may be done through a cystoscope, but never by cutting, for division of the ureter mouth by cystoscopic scissors is likely to result in hemorrhage so severe as to require suprapubic drainage for its relief. The roof of the ureter orifice should be burned through by means of the high frequency spark. The slough will separate in a week.

Extraction of Stone.—The accepted method of encouraging the discharge of stones stuck in the lower ureter is dilatation of the ureter by filling it with as many ureter catheters as it will hold. Using the universal sheath and a telescope bearing two catheters, these are inserted one after the other up the ureter past the stone. The sheath is then withdrawn and reinserted bearing a telescope armed with a Garceau catheter, which is forced up alongside the others. These are left in for twenty-four hours, and withdrawn. The stone may be expected to follow within two weeks. Daily repetition of this operation until the stone appears has been recommended. I have never attempted this. A greater number of catheters may be inserted into the female urethra. But for the male three are about the limit. Beer prefers to insert but one, Dourmashkin has devised a rubber bag to stretch the ureter below the stone. Cunningham and others have devised similar instruments. Each of these requires such special practice that it generally succeeds only in the hands of the inventor.

Instrumental extraction of ureter stones should be attempted only in the absence of infection.

CHAPTER LI

INTERNAL AND EXTERNAL URETHROTOMY

Caudal anesthesia is to be preferred.

The patient is placed in the so-called lithotomy position, upon his back, with thighs and knees flexed at an acute angle and held in this position by leg supports.

EXTERNAL URETHROTOMY WITH A GUIDE

A grooved urethral staff, a sharp-pointed curved bistoury, and a perineal tube are required. The perineal tube is a soft-rubber tube with terminal and lateral eyes, size 28 or 30 F.

The grooved staff is lubricated and introduced well into the bladder to make sure that its point has passed the bladder neck. It is then withdrawn and held by an assistant in such a manner that its curve projects forcefully against the perineum.

The surgeon feels the staff with the forefinger of his left hand and plunges the curved bistoury into the skin of the perineum in the median line about 5 cm. in front of the anus, driving the point of the knife directly into the groove of the staff just where it begins to curve away from the perineum toward the bladder.

As soon as the knife is felt to strike the staff it is pushed inward along this instrument for about 2 cm. and then drawn outward and backward in such a manner as to make an incision through the urethral mucosa, the overlying tissues, and the skin, just large enough to admit the surgeon's finger. As the knife is withdrawn, a grooved director is introduced in its place and the metal staff is then withdrawn, and the surgeon presses his finger forward into the bulbous urethra, guided by the director.

The tight ring of the cut-off muscle is felt, into this the finger is firmly but gently insinuated, thence into the prostatic urethra and into the bladder. These regions are investigated rapidly for whatever diseased condition is supposed to be present. This investigation may be assisted by counterpressure from a finger in the rectum or from a hand on the hypogastrium.

At the close of the operation the perineal tube is grasped with a dressing forceps in such a way as to bend its tip upward. Thus introduced it will not catch in the urethral at the bladder neck. The bladder is then irrigated through this tube both to clear it of clots and to prove that the tube is properly placed to drain the bladder.

The tube is held in place by a silkworm gut suture, piercing the skin and wrapped several times about the tube.

It will be noted that the bladder is readily cleared of blood unless the internal sphincter has been torn, but that a free venous ooze drips from the perineal wound. The wound should only be drained by a wick of rubber tissue, never packed with gauze, no matter how severe the hemorrhage, for the counter-pressure of the dressing upon the perineum readily stops this, while removal of the gauze packed in the urethra is always painful and sometimes excites secondary hemorrhage that requires replacement of the tube and repacking of the wound.

A dressing of gauze is then placed about the tube against the perineum, to be held in place by a T-bandage. Its two ends are laid over the dressing on each side of the tube, crossed in front of the tube, enough extra gauze laid transversely underneath the scrotum to support this well, and the two ends of the T-bandage carried up and pinned to the waistband in front.

The patient's legs are then let down from the supports, and the efficiency of the perineal tube tested by injection. If the injected fluid does not flow out, the tube is not inside the bladder, or is plugged with clots. If it flows out in an irregular and intermittent manner, suddenly stopping off and beginning again, the tube has been inserted too far. By pushing in, pulling out, or removing the tube to examine it for clots, it is finally placed at the proper position. In order to avoid such manipulations after operation, the tube, when first placed, while the patient is still upon the operating table with his legs in the air, should be inserted just far enough to run the fluid smoothly and then pushed in about 2 cm. farther, and fixed in place.

Stern's Method.—In order to avoid injury to the bulb and the inconvenient hemorrhage, the operation may be performed through a V-shaped incision, as for perineal prostatectomy. The bulb is freed from the insertion of the bulbocavernosus muscle and the posterior fibers of this muscle split in the mid-line until the space about 1 cm. long is reached just distal to the membranous urethra where the canal is neither covered by muscle nor by bulb. This space is exposed by retracting the bulb upward away from the canal, and the urethra opened there.

Another Method.—With the staff in the urethra, the skin of the perineum is incised in the median line for a distance of 4 cm., and this incision carried down to the muscles surrounding the urethra.

The bulbocavernosus muscle is divided in the median line, and after this, the spongy tissue of the bulb. The oozing from the bulb is neglected, and as soon as the staff comes into view this is replaced by a grooved director upon which the stricture is cut and the finger introduced into the urethra.

The operation is brought to a close in the manner described above. As the skin incision is unnecessarily long, one or two catgut sutures should be taken through the muscles, and the incised bulbous urethra at the anterior extremity of the incision.

After Treatment.—The tube is removed from the bladder at the end of forty-eight hours, unless some special indication, such as kidney drainage, calls for its retention.

The anterior urethra and bladder are irrigated daily, both before and after removal of the tube, with silver nitrate solution. As soon as the tube is removed, the patient may sit up if his condition permits. On account of the wound in his perineum he will have to sit upon a rubber ring.

After removal of the tube the patient usually urinates through the perineal wound for from a day to a week or so. Thereafter the urine begins to come by the urethra; but from time to time, for several days, the perineal wound may burst open, permitting a gush of urine to come through it, and filling the patient with despair. But he may be reassured by the statement that such an accident is to be expected. The first sound (24 F.) is passed on the tenth day and larger sounds every fifth day thereafter.

Complications.—Hemorrhage, spasm and infection are the three complications to be feared.

Hemorrhage does not occur into the bladder unless the bladder neck has been torn. Bleeding from the perineal wound is unimportant unless packing has been inserted.

Spasm of the bladder is excited by distention of the organ with clots or by obstruction or slipping of the tube. The spasm may also be set up by the mere presence of the tube or of packing in the perineal wound. Clots may be removed by repeated gentle injections and aspirations or by temporarily replacing the tube with a litholapaxy tube and aspirator.

If the spasm is due to the mere presence of the tube, it may be relieved by decompression.

Infection is the great danger. It is a good hospital rule that if the patient has a chill or a sharp rise of temperature while the tube is in his perineum, this should be removed. If removal of the tube is followed by a chill no account need be taken of this unless it is repeated or the temperature remains up for more than twenty-four hours. In that event the small tube should be replaced in the perineum.

INTERNAL URETHROTOMY

If the stricture is anterior to the bulbous urethra, and impassable to any instrument expect a filiform, the Maisonneuve (Fig. 147) urethrotome must be employed. This is screwed on to the end of a filiform, pushed into the bladder, and the knife pushed home. If the stricture of the anterior urethra will admit an Otis urethrotome (Fig. 148), this is introduced, guided, if necessary, upon a filiform, screwed up to 32 F., and the knife then pulled out. It is better not to pull the knife out far enough to cut the terminal inch of the urethra, but to reinsert it into its pocket, revolve the urethrotome a half turn and cut the terminal inch on the floor. Cutting is repeated, the deepest cuts upon the roof

of the urethra, until a 30 F. sound can be readily introduced. A 20 F. rubber catheter is then tied into the urethra.

If the hemorrhage after operation is alarming and does not soon cease, it may be checked by bandaging the penis and making counterpressure on the perineum against the catheter in the urethra.

Internal and External Urethrotomy.—When the stricture requires both internal and external urethrotomy, two courses are open to the surgeon: He may either perform Harrison's operation—*i.e.*, an internal urethrotomy, followed by perineal section—or else he may open the perineal urethra first on a small staff and cut the anterior urethra afterwards. I believe the former operation preferable in most instances.

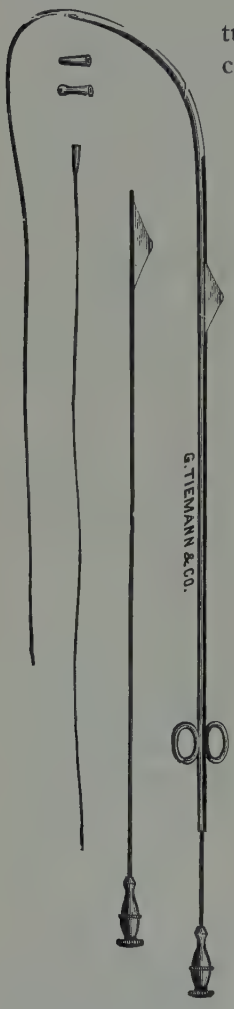

FIG. 147.—MAISONNEUVE URETHROTOME.

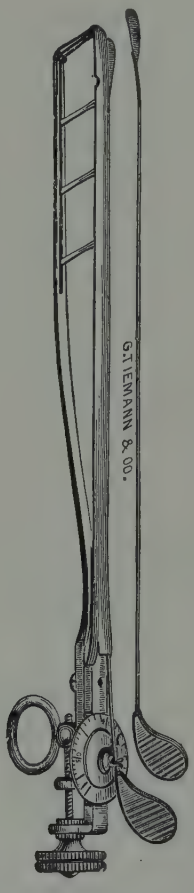

FIG. 148.—OTIS URETHROTOME.

Passage of Sounds after Urethrotomy.—The rule used to be: "Retain the perinal tube four days. Then pass a full-sized sound. If chill follows, replace the tube for four days more." Such a rule is wrong in two essential particulars: the tube should be removed on the first or second day, the first sound passed between the tenth and fourteenth. A sound (25 F.) will be found to pass much more readily then than it would have earlier. If the ureter bleeds freely, reinsert the catheter.

If the stricture recontracts tightly before the tenth day, this shows it should have been resected.

Subsequently sounds are passed every seventh day; no more than two sounds being passed on any one occasion. The full size (30 F.) is not reached until nearly a month after operation.

PERINEAL SECTION WITHOUT A GUIDE

Every effort should be made to insinuate an instrument through the stricture, both before and after the anesthetic has been administered.

A half per cent solution of methylene-blue is injected into the meatus and

milked along the urethra. It will find its way through the tightest stricture into the bladder, deeply staining the tissues as it goes. As much as remains in the anterior urethra is then washed away.

The urethral staff is passed into the bulbous urethra. The median perineal incision is then made a trifle farther forward than usual, opening the urethra freely in front of the stricture—*i.e.*, between it and the meatus. The urethral walls are then pulled apart by loosely knotted sutures or by Allis clamps. The urethra is thus pulled flush with the surface of the wound, its floor slit almost but not quite to the orifice of the stricture, and then, guided by touch alone, the surgeon attempts to introduce a probe through the stricture without perforating its walls.

It is to be remembered that false passages are likely to deviate from the median line. Therefore, the point of the probe should be kept strictly in the median line, and should be guided by the roof of the urethra. Its general direction should be that of the long axis of the patient's body. The injected methylene-blue forms a guide to the urethra.

If the urethra is pulled well up toward the surface of the perineum, and the maneuver is carried out with care, it almost invariably succeeds. A perineal section without a guide is thus turned into a perineal section with a guide, as soon as the probe has passed into the stricture; but, even though it passes apparently in the right track, one should not be too sure that it is not in a false passage. The floor of the urethra is carefully divided along the probe; and, in as much as the tight band of the stricture is usually very narrow, a slight advance brings one to the dilated portion of the urethra behind, which is readily recognizable, after which protruding masses of scar are carefully dissected out, all bleeding is stopped and the operation completed as above decribed.

In case the probe does not pass, two courses are open to the surgeon. The safest method is to do a *retrograde catheterization; i.e.*, perform suprapubic section, introduce a woven catheter, or a prostatic sound or catheter with a long curve, into the bladder, and thence into the urethra down to the posterior surface of the stricture. One then returns to the perineum and opens the urethra on the point of the sound.

The second alternative is to continue in the perineum. The so-called "unerring thrust" of Cock, which consists in plunging the knife blindly into the tissues in the general direction of the apex of the prostate, is a hideous mutilation absolutely to be condemned. The best suggestion is Young's. Transform the median incision into a bilateral one by diverging incisions from its posterior extremity; dissect the perineum widely, as in extra-urethral prostatectomy, and upon reaching the apex of the prostate open the urethra there.

If the median perineal section has been performed under caudal anesthesia, it is often possible to persuade the patient to urinate a drop or two, when close watching will show the hole from which this drop exudes.

OPERATION FOR RUPTURE OF THE URETHRA

1. The patient is anesthetized before any attempt at complete examination is made; the anesthesia I prefer is spinal.

2. Inspect and palpate the perineum to estimate the extent of the hematoma, the rectum to estimate infiltrations about the pelvis, and the abdomen to estimate the degree of bladder distention and the presence of other injuries.

3. Then pass a rubber catheter into the urethra. If it enters the bladder easily, tie it in. Do not operate.

If it will not enter the bladder, its end will often pass straight into the perineal cavity filled with clots and so much fluid blood will pour from the catheter that this will be mistaken for bloody urine and the surgeon may imagine he is in the bladder—though, as a matter of fact, the bladder urine is but little tinged with blood unless the bladder itself is ruptured.

4. If the catheter does not enter the bladder, suprapubic cystotomy is performed. The bladder is distended with urine and can be opened through a very short incision.

5. The patient is then put in the lithotomy position and the perineum opened on a sound or staff: the V-shaped incision gives a much better exposure than the median incision.

6. A superficial perineal hematoma will be found and beneath this it is not improbable that the bulb with its surrounding muscle may appear quite normal; but carry the dissection back as though prostatectomy was going to be performed and before the bulb has been fully liberated, through a tear in its upper surface, one enters a cavity filled with blood-clots in which the urethral guide can be felt but, if the urethra has been completely ruptured, its proximal end can usually not be found.

A sound is then passed retrograde from the bladder into the posterior urethra.

Three or four plain catgut sutures are then inserted into the torn proximal end of the urethra, the retrograde sound withdrawn and a catheter inserted from the perineal wound into the bladder and then retrograde through the anterior urethra out of the meatus.

7. Upon this catheter as a splint, the two cut ends of the urethra are sewn together after the pulpified bits of corpus spongiosum have been removed. The catgut sutures that have already been introduced into the posterior urethra are employed to tie the two ends together. Special attention should be paid to obtaining a good roof for the urethra.

8. The catheter is then withdrawn from the urethra and drainage established for twenty-one days by the suprapubic tube. The perineal wound is closed over the bulb but rubber tissue drainage is provided throughout the lacerated region.

9. Kidd begins after treatment by urethroscopy at the end of the third week. I prefer to proceed merely by dilatation of the urethra and consider it

a good plan at this time to tie in a rubber catheter, if one can be inserted without too much trauma to the partially healed urethra.

10. If no catheter can be inserted, the suprapubic tube is left in until the urethral right of way is established, for retrograde catheterization makes the first dilatations of the urethra very much easier.

11. Once the surgeon has established his ability to pass instruments through the urethra he will continue to dilate as for stricture but with the consciousness that the traumatic stricture is often a very rebellious one.

RESECTION OF THE URETHRA

Traumatic strictures of the urethra usually need resection; so do the cases of gonorrheal stricture that are complicated by periurethritis. The principles that govern the operation are three:

1. First cut away all masses of scar tissue until fresh tissue is reached. Then split up all sinuses and undermined places according to the rules for operation upon periurethral phlegmon.

2. Spare the roof of the urethra, if this is possible, as this is the guide for subsequent passage of sounds. If this is not compatible with the efficient removal of scar, sacrifice the roof and complete the operation as for rupture of the urethra, including the suprapubic drainage.

3. Make no attempt at obtaining a permanent cure at the first operation if the perineum is infected. The actual resection must be postponed until the perineum is clean.

The resection is then undertaken by Cabot's method, if the stricture is in the bulb and not more than 1 cm. wide; by Pasteau's method, if in the membranous urethra or extensive.

Cabot's method of urethral resection for stricture is the following:

The urethra is disclosed through a median perineal incision and the bulbocavernosus muscle divided longitudinally for a distance of about 3 cm., with the center of the incision at the tightest point of the stricture, as indicated by the distance a sound will go in the urethra. The bulb which is thus laid bare is dissected free from the corpora cavernosa, from the triangular ligament forward for two or three centimeters. It is then opened in the usual manner and the stricture carefully divided. With a 22 F. sound in the urethra the mucous membrane and overlying spongy body are then reunited by catgut sutures which close the longitudinal wound transversely thus puckering up the urethra longitudinally and enlarging the stricture. A puncture is then made in the bulb or membranous urethra posterior to this line of suture and a 16 F. soft-rubber catheter inserted into the bladder for drainage (suprapubic drainage is preferable to this). Cabot advises daily injection of argyrol into the anterior urethra. I believe it preferable to inject nothing. The perineum is widely drained. The first sound is passed at the end of two weeks. The urethra may be found relatively distorted and pocketed.

Pasteau's operation is performed in two stages. The first procedure is for the purpose of excising the stricture and bringing the two cut ends of the urethra to the surface of the perineum. A median perineal section is performed, the urethra exposed, its strictured area excised. This leaves a gap, perhaps 2 cm. long, the posterior section of the urethra deep in the perineum. This is freed, if possible, enough to make it point toward the skin. The skin edges are then brought down to the edges of the urethra and sutured to it. Not infrequently this urethrostomy is not very neat. A 24 F. catheter is then tied into the urethra to splint the urethral wound open. The cut end of the anterior urethra is then freed and brought up to and sutured in the skin. The skin intervening between the two urethrostomy wounds and the underlying tissues are then brought together with generous rubber tissue drainage.

The catheter is removed in five days and both openings dilated by the passage of sounds for six months. Then the reconstruction operation is performed. First the bladder is drained suprapubically; then the two urethrostomies are surrounded by an elliptical incision and the underlying tissues dissected free to permit the two ends to be sunk into the perineum. The oval flap is turned in over them and the perineum built up as well as may be to cover them. Rubber tissue drainage.

The suprapubic tube is kept in until the freedom of the urethral channel is assured by the passage of sounds. This operation gives excellent results.

Implantation of a section of the saphenous vein or of the appendix to replace long sections of the urethra almost always fails.

Fistulæ of the pendulous urethra with great loss of tissue cannot be closed.

DRAINAGE OF PERIURETHRAL PHLEGMON OR GANGRENE OF GENITALS

Whether the condition is due to primary gangrene of the penis or scrotum or to gangrenous periurethral infiltration—commonly known as infiltration of urine—the operative treatment is the same.

The patient is put in the lithotomy position and the inflamed and swollen field of operation inspected and palpated so that before any incision is made an approximate estimate may be had of how far this incision must extend in order to open with one cut all of the infiltrated area and leave no undermining pockets whatsoever.

The main incision must be in the mid-line of the perineum and in as much as the scrotum is usually involved in the infection, it must split the scrotum to the penoscrotal angle.

With the two halves of the scrotum drawn to each side, the sloughing fascial tissue is cut away until the scrotal skin has been emptied of as much of the gangrenous tissue as possible. With the finger or a blunt clamp the edges of the incision are then explored and opened up by secondary incisions radiating from either extremity of the central perineal incision into one or both buttocks

and into one or both groins (Fig. 149). In either direction the subcutaneous infiltrate may extend so far that from this secondary branching incision further subincisions must radiate in order that no pockets shall be left. If the pubes is undermined, radiating incisions from the two groin incisions meet above the penis so that the skin around this is entirely divided. In all directions the flaps are lifted up and the gangrenous tissue excised.

One then turns one's attention to the urethra, passing a sound as far as possible and if stricture is found, operating upon it as elsewhere described.

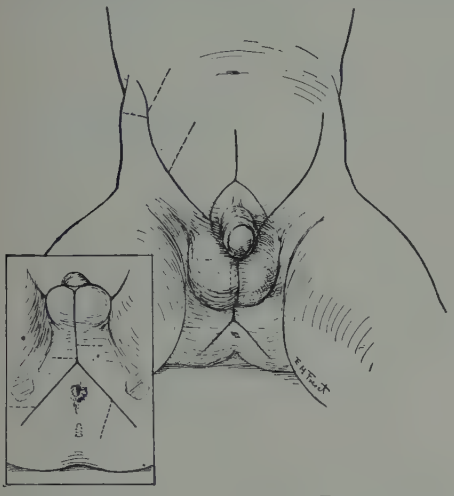

Fig. 149.—The Incision for Periurethral Gangrene in Mid-Line of the Perineum Branching to Buttocks, to Groins and Around Penis.

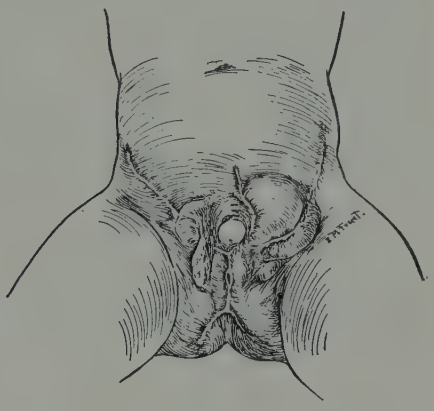

Fig. 150.—Drawn from a Patient at Bellevue Hospital Who Had Submitted to an Extensive Operation and Whose Wounds Were Not Yet Healed.

The patient was a negro and the scar deformed by keloid. The testicles were drawn into the groin. A fistula remained open in the perineum to be closed by secondary operation.

A thought is then given to the prostate and the openings of the ischiorectal fossæ explored and drained by blunt dissection if any infection is found in them.

At the close of the operation the enormous ragged wound is packed with vaseline gauze which must be changed daily.

OPERATION FOR THE RELIEF OF INCONTINENCE OF URINE

Incontinence of urine in women is attacked either from the vagina or suprapubically. The vaginal operation is performed as follows: With the patient in the lithotomy position and a sound in the urethra the vaginal mucosa is slit vertically over the urethra and the tissues divided until the urethra is reached. Dissection is then carried laterally until a sufficient bite can be had of the sphincter muscle to permit it to be drawn tightly around the urethra with fine chromic gut sutures. The vaginal incision is then closed. Care must be taken not to open the urethra.

If there is much scar about the urethra the vaginal operation will fail to discover adequate muscle and cannot succeed. The muscle must be sought above the pubes. Through a median hypogastric incision the distended bladder is exposed and dissected free from the pubes until the urethra, in which a sound has been placed, can be plainly identified. The sphincter muscle is then sutured with chromic gut about the roof of the canal and the suprapubic wound closed about a small tube.

Incontinence of urine in the male has been attacked by Young in six cases with one perfect result followed fifteen years, two good results followed apparently less than a year, and two failures. The technic embraces a suture of both sphincters.

The bladder is opened, the scar occupying the lower part of the bladder neck, and adjoining trigone excised and the mucosa of trigone and urethra sutured together from side to side, constricting the urethral orifice to a small size.

The suprapubic wound is then closed around a small tube, the patient put in the exaggerated lithotomy position, the perineum opened by a V-shaped incision, as for prostatectomy, the mass of perineal scar cut away from the membranous urethra, the redundant urethral mucosa excised, the remains of the external sphincter brought together beneath the urethra. The urethral mucosa is sutured with plain catgut, the muscle with chromic gut. The perineum is closed about a drain.

The suprapubic tube is retained eighteen days and a few days later urethral dilatation is begun. The first attempts to dilate are impeded by the suture at the membranous urethra or that at the bladder neck.

One may doubt the wisdom of closing the bladder neck. Subsequent sclerosis will surely sometimes cause retention and this the patient, who was operated on in the first place for prostatic retention, would not relish. I have preferred to operate solely on the perineum and it has seemed to me preferable to attempt to keep out of the urethra so as to get better healing. Three patients were operated upon in this way with one cure. A fourth case baffled me by presenting no trace of cut-off muscle to bring together under the urethra. But the edges of the levatores ani looked firm, so these were brought together under the urethra in place of its own muscle. The patient, who had been in complete incontinence for two years since his prostatectomy, improved slowly and attained complete continence after three months. I have followed him for four years. He remains dry excepting that a violent cough or sneeze forces a gush of urine through the urethra.

Other muscles, the gluteus, the gracilis, have been employed to compress the urethra.

One gets the impression that doubtless the successful result of such operations is chiefly due to partial obstruction of the urethra by scar about it.

CHAPTER LII

OPERATIONS FOR THE CURE OF URINARY FISTULA

Treatment of fistulæ discharging urine, whether they connect with the kidney, the ureter, the bladder, or the urethra, is primarily expectant. *If retention is not present, the fistula will heal, unless there is considerable loss of tissue, tuberculosis or carcinoma.* If there is retention, this must, of course, be removed before the reëstablishment of urinary flow through the natural passages can be looked for.

Among the injections employed to encourage healing, lipiodol and boracic acid ointment are useful.

The surgical principle of operations is the separation of the visceral and cutaneous ends of the fistula, suture of the visceral orifice, or, if the fistula is between two viscera, suture of both visceral orifices, and the interposition between the two ends of the fistulous tract of a thick body of normal tissues after the tract itself has been excised.

Tuberculous fistulæ may heal spontaneously, though they have existed for months. "Debridement," *i.e.,* excision of the fistulous tract, expedites healing.

Carcinomatous fistulæ do not heal.

RENAL FISTULA

Urinary fistula in the loin, following operation upon the kidney, will heal unless there is obstruction to the normal urinary outflow, or unless there remains a tuberculous kidney or ureter within the loin. The operations for the relief of these fistulæ consist, therefore, in the relief of urethral or renal retention, if these be present, or in the removal of the disorganized kidney or ureter. Previous to operation on non-tuberculous cases an attempt to encourage the closing of the fistula by the prolonged retention of a ureteral catheter should be made if this is practicable.

Removal of ureteral obstructions has already been discussed. Nephrectomy of an old pyonephrotic kidney, which has long been fistulous, is one of the most difficult and dangerous operations of urinary surgery.

Basing his practice upon the researches of Hermann and Nicolai, Holt has suggested and practiced ligature of the renal pedicle for the purpose of avoiding the difficulties of this operation. He incises the anterior abdominal wall along the outer edge of the rectus, pushes the large and small intestines toward the median line, and incises the peritoneum over the renal vessels to the outer side of the mesocolon. The retroperitoneal tissues are then separated toward the

vertebral column until the renal artery and vein are discovered. If the adhesions are so dense as to make this separation difficult, it may be preferable to incise the posterior peritoneum internal to the colon, and proceed with the ligature of the renal vessels in the space between the colic arteries. The artery and veins are tied separately, and a careful search made to be sure that no accessory renal vessel has been overlooked. The wound is then closed in the usual manner.

I have always preferred nephrectomy. I have never failed to get the remains of the kidney out.

Late Renal Fistula.—On two occasions I have known fistulæ to reopen in the loin years after nephrectomy for calculous pyonephrosis. In each instance the operation had consisted in the removal of a mass of fibrotic tissue containing pus and calculi with no definite demarkation between pelvis and parenchyma. The parenchyma had been wholly removed, the pelvis deliberately neglected.

The cause of the reopening of the renal fistula was in each case a communication through the sclerotic and shortened ureter with the bladder. One of these had a ureter that ran in a straight line from bladder to kidney pelvis, its bladder orifice retracted 5 cm.

Such fistulæ require division of the ureter and excision of its upper end, after which the fistulous tract itself, if merely curetted, will promptly close. The excision of the ureter is best done by entering extraperitoneally at a point well below the lumbar scar and following the ureter up to where it opens into the fistula.

URETERAL FISTULA

If incomplete, treatment should be attempted by the indwelling ureter catheter; if complete, the choice is between reimplantation of the ureter into the bladder, the bowel or the skin, or nephrectomy if the opposite kidney is adequate.

VESICAL FISTULA

Hypogastric vesical fistula will usually close if the urethral obstruction is relieved and there is no great loss of tissue. The retained urethral catheter may be of assistance. Even though the fistula remains open for many weeks or opens and closes intermittently, the surgeon should not be too hasty in suggesting operative relief, but should reserve this for cases that have proven absolutely rebellious for months.

The operation should be frankly intraperitoneal. It consists in excision of the fistulous tract, freeing the wall of the bladder, and closure of the fistulous orifice in the bladder wall by mattress-sutures, reënforced, if possible, by a layer of Lembert sutures. The abdominal wound may be left open, or the muscles may be caught together over a small drain. The retained urethral catheter should be employed, if possible.

The operation for *vesico-intestinal fistula* is an intestinal, not a vesical problem.

Vesicovaginal Fistula.—See Chapter XXXIV.

URETHRORECTAL FISTULA

Such fistulæ as I have operated upon have been small. They have healed after the following operation:

1. Suprapubic cystotomy for drainage.

2. Exposure of the fistula through the U-shaped prerectal incision. The perineum is replaced by scar, distorted and thin. The dissection must be guided by a finger in the rectum as well as the sound in the urethra. The rectum must be freed well above the site of fistula.

3. The urethral end of the fistula is then excised and the orifice sutured about the sound which is then withdrawn.

4. The rectal end of the fistula is treated in like manner and sutured with fine chromic gut, in two layers.

5. The rectal sphincter is stretched.

6. The perineum is built up by suturing the edges of the levators to each other. (Squier inserts a fat transplant.)

7. Rubber tissue drainage in front of the levators.

Young and Stone [1] report the cure of ten out of eleven complicated cases by the operation of Tedenat. This begins with the establishment of a suprapubic fistula; then the anus is circumscribed by an incision dividing the mucosa at the mucocutaneous margin, and extending anteriorly along the median line of the perineum, thus having a racket shape. The mucous membrane of the bowel is freed as in the Whitehead operation high enough to permit the orifice of the fistula to be drawn down outside of the anus. This loosening is assisted by deepening the "handle" of the racket-shaped incision in the mid-line of the perineum in front, and division of the fistula between the rectum and the urethra. The urethral end of the fistula thus laid bare is then carefully sutured and healthy tissues brought from side to side to protect it. Four stay sutures of chromic gut are then taken in the rectum to hold it down, the excess including the rectal orifice of the fistula cut away, the rectal edge sewed to the skin after the sphincter muscle and the levators have been pulled together in front by stout chromic gut sutures in order to reconstruct the perineum.

If the above operation is impossible, the fistula may be changed into a urethroperineal one by Albarran's procedure of freeing the rectum by a posterior, U-shaped incision carried up to beyond the point of fistula. Lateral incisions are then made in the rectal wall and carried forward to meet in a V above the fistulous orifice on the anterior wall of the rectum. The two edges of this V are then united so as to leave a urethral channel running to the perineum. The posterior edges of the V are also then united, thus isolating the rectum from the

[1] *J. Urol.*, 1917, i, 289.

new urethroperineal fistula. After healing has taken place, the urethroperineal fistula is closed by a secondary operation.

URETHROPERINEAL FISTULA

Perineal urethral fistulæ will almost always close, unless they are tuberculous or cancerous, by the lapse of time, if the caliber of the urethra is kept open by sounds, and the fistula repeatedly curetted. If these means fail, the fistula may be closed by free dissection of the perineum, excision of the scar, and suture of the urethra, over which is drawn a thick layer of the urethral and perineal muscles. The urine should be diverted through a suprapubic incision.

PENIAL FISTULA

Fistula of the penial urethra, if small, may be closed by circumcising the fistula on a sound in the urethra and turning the edges in and suturing over them, in several layers. The skin is left open.

Larger fistulæ require preliminary suprapubic drainage, freshening and inversion of the edges and a second layer of sutures to the corpus spongiosum. The more simple the operation the more likely it is to succeed.

The wee fistula left by frenal abscess is actually a small abscess cavity draining both into the urethra and to the skin. Under local anesthesia the skin is widely incised and the abscess wall excised as far as this is possible. This leaves a small opening into the urethra. No attempt is made to close this, but the epithelium or granulation tissue lining this tract is cut away, care being taken to enlarge the fistula as little as possible.

In the course of three weeks the fistula will usually close spontaneously. If it does not, the edges are burned with the high-frequency spark. This sufficiently encourages cicatrization.

CHAPTER LIII

OPERATION FOR MALFORMATION OF THE URETHRA AND BLADDER

MEATOTOMY

A CRYSTAL of cocain is deposited in the meatus and left there for ten minutes. A blunt-pointed bistoury is then inserted into the urethra with its cutting edge downward. Sudden sharp lateral pressure is then made on the glans penis and the knife quickly withdrawn. The external meatus is thus readily cut, but if the internal meatus is also strictured, this may have to be recut before the 28 F. sound, which is used as a calibrator, will pass freely into the urethra. A catgut suture on each side then catches the urethral mucosa to the skin.

The anesthesia during the cutting is due more to the pressure than to the cocain. By distracting the patient's attention and concealing the bistoury it is often possible to divide the meatus before he is aware any operation is contemplated.

If only the mucosa at the meatus has been cut no sutures are needed. But if the glans has been divided alarming secondary hemorrhage will ensue unless the incision is sutured. If the patient is not apprehensive the single suture of mucosa to skin on each side, which is all that is required, may be inserted without any further anesthesia. Otherwise it is well to infiltrate with a very fine needle both under the mucosa and under the skin. The sutures should be of plain catgut.

If sutures have been introduced these will keep the wound open on condition that a sound is passed at the end of a week. If the wound has not been sutured it must be kept open by pulling it apart and inserting a sound through the meatus every day for the first three days.

OPERATIONS FOR HYPOSPADIAS

Beck's Operation.—This consists in liberating the urethra, bringing it forward and suturing it to an orifice punched through the glans. The urethra must be freed well back to prevent incurvation. This operation is applicable only to balanitic hypospadias and to a penis without any congenital incurvation.

Operation for Penial Hypospadias.—The operations are many and various. Certain preliminary steps are necessary in almost all cases.

First, *the penis must be freed from its scrotal adhesions.* If these are slight, a transverse incision through the penoscrotal frenum will, when sutured in a

longitudinal direction, suffice to free the organ. But if the penis is deeply buried in the scrotum the integument of the former must be derived from the latter with regard only to covering in the penis; the scrotum will, by virtue of its looseness, adapt itself to the loss of almost any amount of skin.

Secondly, the *incurvation of the body of the penis demands attention.*

This incurvation is due to a twofold pull. The skin itself holds the penis down to the scrotum. More important than this, however, is the fibrovascular mass that represents the undeveloped corpus spongiosum and lies between and below the corpora cavernosa. This fibrous tissue is palpably shorter than the cavernosa and is felt through the skin as a tense fibrous band when the penis is held as erect as possible.

The result of this downward pull is to impart a fixed curve to the cavernosa. Growing for years in this arched position their crook is more or less incurable.

A second result is to pull the glans penis downward at the time of its first development so that it sets aslant on the ends of the cavernosa, like a cap pulled down over the eyes instead of sitting straight on the top of the head.

Manifestly we have here elements of incurvation some of which are curable and some incurable. It is easy to cut the skin and superficial tissues transversely and sew them longitudinally. This is all that some cases require, but they are few. In order to straighten the penis as far as possible, it is usually necessary to dissect out the remains of the spongiosum from meatus to glans. After exercising all accessible bands the skin, cut transversely, is sutured longitudinally and the penis bandaged up to its tip, which is left free so that a catgut suture may attach it to the abdominal wall. The result of this is quite the opposite to the Beck operation, for it leaves the meatus further from the glans than ever. But the Beck operation is only applicable to cases that actually require an operation only for cosmetic reasons.

Yet even with the fibrous band out the corpora may still be round-shouldered, the glans may still be slumped forward on them. How to cure these fixed deformities I do not know. I have attempted in vain to plicate the dorsum of the corpora and to separate the glans from them so as to "put the hat on straight." I have failed.

An apparent straightening may be effected by denuding the under surface of the glans and suturing the denuded area transversely with silver wire, to be left in two weeks.

This preliminary operation should be performed as early in life as possible. The reconstruction of the urethra must be left until puberty.

This reconstruction is an unsatisfactory procedure. No operation supplies a new corpus spongiosum. Hence the new urethra is a flabby tube of skin from which the last drops of urine must be milked out. The patient fancies he will be much happier with his urethra terminating at the end of his penis. Indeed, the decision may be forced upon him by the stupid regulations such as that which makes the slightest hypospadias an impediment to admission to West Point. Moreover, the bringing forward of the meatus may be essential to his

fertility. But even this difficulty can be overcome by artificial insemination. In short, I never urge a patient to be operated upon for hypospadias except for straightening the penis and for such minor surgery as may be necessary to place the meatus so that it will not dribble or spray the urinary stream. The hypospadic meatus often requires meatotomy.

Reconstruction of the urethra is a two-step operation. The first step is a suprapubic cystotomy or perineal urethrotomy to divert the urinary stream. I prefer the former. Young does perineal section and in front of this ties a silk suture around the urethra over a perineal pad just tight enough to compress the canal and prevent urine from escaping through it and not tight enough to leave stricture. Others prefer perineal urethrostomy; *i.e.*, an opening of the urethra and suturing of it to the skin over a wide enough opening to permit all the urine to escape.

For reconstruction of penial hypospadias one must choose between a bewildering number of operations.[1] I believe Bucknall's the best.[2] Two parallel incisions, 1 cm. apart, are made from the glans penis to the hypospadic meatus and an equal distance beyond, on the anterior surface of the scrotum. If any hairs are growing on the skin they are destroyed by minute excision of their roots. The outer edge of these two incisions is dissected up far enough to give a good surface for suture. The two raw surfaces are folded upon each other by sutures of dermal silk tied over a rubber tube externally so as to be easily removable. Thus the scrotum and penis are drawn together, the new urethra running between them. Four weeks later scrotum and penis are separated by an incision that runs down each side of the penis in the angle between it and the scrotum, thence over to the posterior surface of the scrotum, meeting in a V over the base of the penis. This leaves a patch of scrotal skin over the venter of the penis. Suture of the skin wounds completes the operation.

This operation has great advantages over any other with which I am familiar. It does not tunnel the glans, and thus avoids stricture at this point. It leaves no fistulæ to be repaired, no strictures to be cut, which are the curse of all other operations. But the ejaculation of semen will not be complete until the urethra is milked out.

OPERATION FOR EPISPADIAS

Young[3] has been successful with the method of Cantwell, which consists essentially in perineal diversion of the urinary stream followed by splitting the penis in two longitudinally through the septum of the corpora cavernosa, leaving the dorsal gutter, representing the urethra, attached to one of the corpora, suturing this gutter around a catheter to form a new urethra, and rotating the corpus to which this urethra is attached on its long axis so as to bring the

[1] *Cf.* Mayo, *J. Am. M. Ass.*, 1901, xxxvi, 1157; also Young's *Urology*, ii, 601.
[2] *Cf.* Churchman, *Ann. Surg.*, 1920, xlvi, 487.
[3] *J. Urol.*, 1918, ii, 237.

urethra below the corpora, which are then sutured together in their normal relation, the urethra between and below them. Young states that even incontinence of urine is no bar to the success of this procedure.

OPERATION FOR EXSTROPHY

No one has yet constructed a functionally adequate bladder out of the exstrophic sac. Trendelenburg [4] claimed to have done so, but Duenkeloh [5] disposes of this claim. When the bladder is successfully inverted it does not function. Incontinence is all but complete.

The Mayos prefer Coffee's operation to divert the urinary stream into the bowel. They report twenty-two successes out of twenty-six cases operated upon. No other surgeons have done as well. Hutchins and Hutchins [6] have reviewed the subject and conclude that the Peters operation is preferable.

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[4] *Ann. Surg.*, 1906, xliv, 281.
[5] *Deutsche Ztschr. f. Chir.*, 1914, cxxix, 71.
[6] *Surg., Gynec. & Obst.*, 1923, xxxvi, 731.

CHAPTER LIV

OPERATIONS UPON THE SCROTUM AND TESTICLE

Local anesthesia is the best for operation upon the uninflamed scrotal contents, spinal for gangrene of the scrotum or tuberculosis of the epididymis, general for epididymitis. Caudal anesthesia is usually inefficient. My own preference is for local anesthesia especially as a training for young men. With it they must make careful anatomical dissection or they will come to grief so badly that the catastrophe cannot be concealed.

Local anesthesia for the scrotum is usually obtained by direct infiltration of the tissues to be incised, supported by the injection of 10 c.c. of 0.5 novocain solution into the neck of the scrotum.

Local anesthesia for the testicle, the epididymis and the tunica vaginalis is obtained by block anesthesia of the spermatic cord. There are two ways of obtaining this:

The cord may be infiltrated with 10 c.c. of 1 per cent novocain as it lies in the inguinal canal. In order to accomplish this the external ring must be identified and the needle plunged in just above and external to this point. The operator must be able to identify the sensation produced when the needle passes through the external oblique aponeurosis. As soon as this resistance has been met and passed the novocain is injected.

But if the ring is hard to identify the scrotum may be anesthetized and incised until the cremaster is reached. Then this is split above the testicle and the fascial sheaths of the pampiniform plexus and the vas separately identified and injected with 1 per cent novocain.

ASEPSIS

It is more difficult to cleanse the skin of the scrotum than that of any other part of the body. Preoperative preparation should therefore consist of a good soap and water scrubbing and immediately before the operation the scrotum and surrounding regions should be painted with mercurochrome-acetone-alcohol mixture.

Whatever the antiseptic preparations, the wound will be infected if it is mauled. Operations upon the scrotum must be performed with precision and neatness. It is especially important that fingers be kept out of the wound as much as possible and that once the skin has been incised, it should be regarded as not clean and the dressings clamped to the edges of the wound just as is done for peritoneal cases.

POSTOPERATIVE DRESSINGS

The tissues of the scrotum swell as magnificently as do those of the eye. A special postoperative dressing must always be applied. The best dressing is made of adhesive plaster and suggests the adhesive plaster dressing for support of the inflamed testicle just enough to be confusing to the interne. Let him remember, however, that the purpose of the two bandages is entirely different. The postoperative bandage here described is for the purpose of maintaining pressure; the suspensory bandage for inflamed testicles is for the purpose of immobilization and protection from pressure.

The operative wound should be protected by no more than a single pad of gauze. Other small pads may be placed in the crevices between the scrotum and

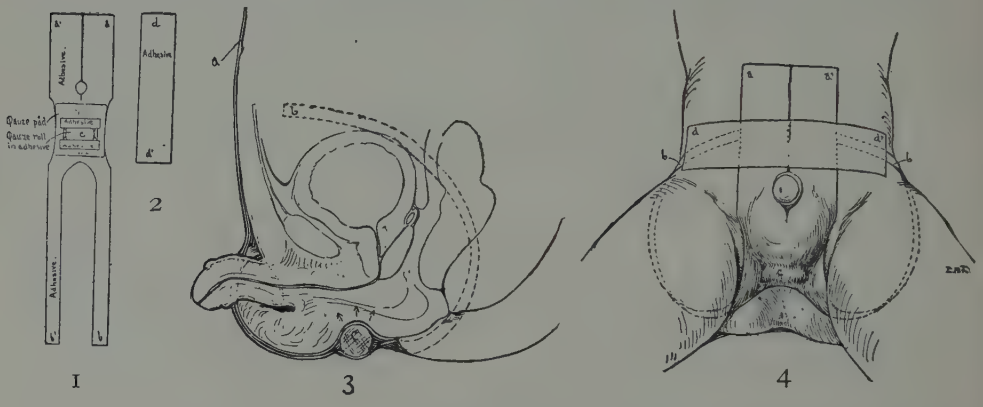

FIG. 151.—THE POSTOPERATIVE SCROTAL COMPRESSION DRESSING.

1. Adhesive plaster dressing; 2, transverse suprapubic band; 3, sagittal section showing the pressure behind the scrotum; 4, frontal view showing the perineal bands crossing the anterior superior spine.

the thighs, but the interne's natural inclination to pile up dressings must be repressed. The less gauze there is beneath the adhesive plaster, the better.

The bandage is made from a single piece of adhesive plaster 4 or 5 inches wide and a yard long. A central square of this is left with the backing on the adhesive plaster and this square is estimated as about the same size as the scrotum. At the edges of this the backing is picked up and split and from this point outward to the end, each end of the adhesive plaster is split longitudinally down its middle. From one split end a V is cut away extending from the central square to the tips of this split end. At the point of the V a small pad is fastened to support the scrotum.

The dressing is applied as follows: The patient's hips are abducted and flexed to an angle of 45 degrees. With the scrotum elevated, the bandage is placed so that the pad comes at the center of the perineum. The gluteal straps are then carefully placed around the gluteal crease by a gesture which strips off the backing at the same time that it makes tension so that the adhesive plaster sticks

precisely in the horizontal fold of the buttock and then extends obliquely upward and around the hip, pointing to or even crossing the anterior superior spine. Before letting the legs down, the split above the intact square is deepened so that when the bandage is applied there shall be no pressure whatever upon the urethra. The two split ends of the bandage are now run directly upward over the abdomen, closely encircling the penis and meeting in the mid-line above it. A little edge of each side is tucked in around the penis so that this may not be adherent and it is kind to spare the pubic hair by placing an additional pad of gauze over this. The bandage is then still further compressed by two or three horizontal strips of adhesive plaster above the pubes which reach far enough laterally to include the ends of the gluteal strips. When the thighs are let down, the bandage is a snug one and will prevent hemorrhage. Indeed, it is so snug that the patient may insist upon its removal the day after operation. It is convenient to loosen the bandage by splitting it horizontally over the pubes, dropping the scrotal flap, exchanging dressings and then patching the breach in the adhesive plaster.

After this bandage has been worn two or three days, however, it is wiser to exchange it for the adhesive suspensory bandage described in Chapter LVIII.

OPERATIONS FOR SCROTAL GANGRENE

There is an almost universal misunderstanding, even illustrated in one of the most recent textbooks, of the proper way to handle cellulitis or subcutaneous gangrene of the scrotum. Multiple incisions are never permissible. The skin over the inflammatory lesion must be slit so widely that there will be no overhanging edge to prevent the wound being packed wide open with vaseline gauze.

If such incisions are to be extensive, the main incision must be made in the mid-line of the scrotum whence branches may run over each inguinal region and downward through the perineum over each buttock (Fig. 149). The more vicious gangrenous infections can almost always be controlled by sweeping incisions, but I have known a life lost because of hesitation to prolong the incision up over the ribs; it was controlled everywhere except at this point whence the infiltration went on until the patient was overcome. There is no danger in cutting skin.

The infection often seemingly extends rather laterally than centrally and one may be tempted to carry a cut up the fold of the groin. This should never be done for two reasons. It is a filthy angle to keep clean and the incision lateral to the spermatic cord does not follow the infection which runs up the groin mesial to the spermatic cord. Such an extension of the infection will be overlooked unless the primary incision is made in the raphé of the scrotum.

Resections of the uninflamed scrotum are a waste of time excepting those that are performed for lymph-block. These consist essentially of removing the

redundant hard edema chiefly from the center of the mass and avoiding the groin crease as much as possible.

Resections of the scrotum for plastic purposes are scarcely necessary. The widely gaping wounds left, after bisection of the scrotum and evacuation of its gangrenous fascia, heal in six or eight weeks, the elasticity of the scar tissue pulling the flexible skin over the defect.

The one essential rule for operations upon the uninflamed scrotum is that hemorrhage shall be thoroughly checked, for the subcutaneous tissues, like those of the eye, swell enormously.

VASOTOMY

The vas deferens is identified by grasping the tissues of the spermatic cord between the thumb and index finger and permitting them to slip to and fro from the grasp until the thick, cordlike vas is distinctly appreciated. This is usually to the inner side of the cord. If the scrotum is thick and short it should

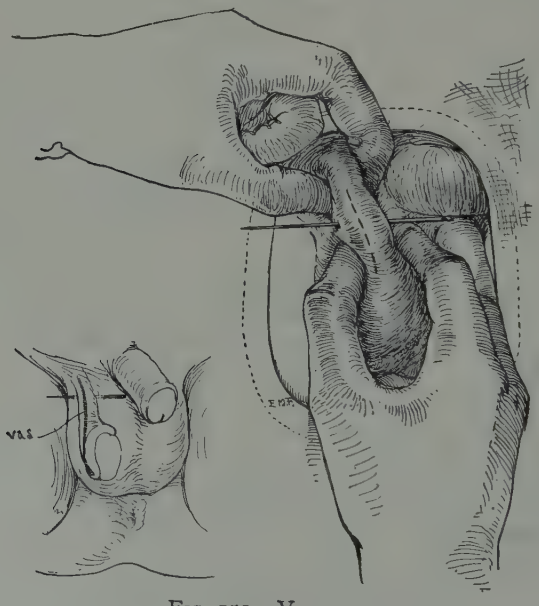

FIG. 152.—VASOTOMY.

be transfixed behind the cord with a straight needle to facilitate the isolation of the vas (Fig. 152). The point at which the vas is most readily accessible having thus been identified, it is anesthetized by infiltration. The vas is then brought back under the infiltrated area and pressed against it. The skin and underlying tissues are divided and the vas brought into the wound, where it may be tied or opened, or a piece of it excised. The small skin-wound is then closed by suture, care being taken to include all bleeding points. Ligature of the vas to

prevent epididymitis implies, (1) division of the vas and (2) ligature of the surrounding vessels and lymphatics, and (3) placing the ends so that they will not reunite.

Belfield's operation for drainage of the vas deferens and irrigation of its ampulla is performed in a similar manner; but when the vas is divided a fine silk suture is passed into the wall and out through the lumen of the upper segment, then in from the lumen and out through the wall of the lower segment. This suture is tied loosely, and after the irrigations have been performed to the satisfaction of the operator, it is tied tightly in the hope that the vas may reunite patent. Such reunion would seem improbable, yet it has been verified in several cases. The sterility which is likely to result from this operation is its chief objection.

OPERATION FOR VARICOCELE

The Open Operation.—Incision in groin, as for a hernia. In subsequent manipulations care must be taken to keep away from the testicle. If it is brought into the wound or traumatized, hydrocele will result.

The external inguinal ring is exposed and the pampiniform plexus of veins identified as they issue from the ring.

The cremaster is divided longitudinally and the veins freed from their surrounding fascia and divided between clamps.

The upper end is securely ligated at a point more than 1 cm. above the cut end. Otherwise the ligature is likely to slip off.

The intercolumnar fascia is divided, and with the handle of the scalpel a tunnel burrowed beneath the external oblique to a point opposite the internal ring.

The veins are pulled upward, and freed by blunt dissection, until the testicle has been drawn into the upper part of the scrotum, about 2 cm. higher than it should lie.

The veins are transfixed and securely ligated, so as to be absolutely sure that this suture, upon which traction is to be made, cannot slip. This suture should be placed on the veins at such a level that when tied at the internal ring the testicle will be suspended in the upper part of the scrotum.

With an aneurysm needle each end of this suture is introduced into the inguinal canal and forced out through the external oblique aponeurosis opposite the internal ring, and there tied.

The wound is closed without drainage.

The operation as above described was devised in 1918 by Vincent, and has been used on my service at Bellevue since that time. It is the only operation that sufficiently suspends the testicle to relieve the pull upon the vas which is the usual cause of the testicular neuralgia of which the patient so often complains.

Subcutaneous Ligation.—Subcutaneous ligation, devised by my father, is an excellent operation for the relief of varicocele, and has the advantage of

detaining the patient in bed for only a day or so. But it does not relieve pain, and it is some years since I have performed it.

The requisite is a ligature of stout braided silk that cannot be broken by any pull the surgeon puts upon it. No absorbable suture will obliterate the veins.

With this ligature the scrotum is transfixed between the vas and the veins, the ligature reintroduced through the same puncture in the skin, and passed around externally between the veins and the skin, thus surrounding the pampiniform plexus. It is then tied, and the bit of dartos, caught fore and aft in the bite of the ligature, pulled forcibly free.

Resection of the Scrotum.—I have never resected the scrotum for the relief of varicocele, for the elastic skin retracts quite sufficiently when the weight of the testicle is taken from it.

OPERATIONS FOR HYDROCELE

Tapping.—This requires no anesthetic. The skin is made tense, and after the position of the testicle has been identified by the light test, a trocar or large needle is plunged into the anterior part of the mass, a little below the center. The testicle is thus avoided.

If the testicle is wounded, the patient complains of some pain and the serum withdrawn is bloody. This accident results in immediate refilling of the hydrocele with blood; but no other complication need be feared. If several months elapse before the hydrocele is tapped again, the fluid will usually be found limpid and straw-colored, the blood pigment having been resorbed.

Injection.—The only instruments required are an aspirator with a large needle, a hypodermic syringe and needle, and some pure carbolic acid crystals deliquesced by heat.

The hypodermic needle, detached from its syringe, is first plunged into the anterior surface of the hydrocele and watched until the appearance of a drop of serum announces that its point is within the cavity. Then the aspirating needle is introduced and the fluid exhausted, *if possible, to the last drop,* since every drop of serum remaining dilutes the acid to be injected. The blood transfusion apparatus makes an excellent aspirator. Relapses are said to be less common if one irrigates the cavity with salt solution.

Meanwhile, the hypodermic needle has not been disturbed. It is now screwed to its syringe, filled with pure carbolic acid, and 0.5 to 1 c.c. (5 to 15 minims) injected into the sac. This is smartly rubbed for a moment, and the skin bathed with alcohol where any acid has touched it.

The subsequent pain is momentary. The operation requires no anesthetic.

The patient usually prefers to remain in bed for one or two days after the operation, though this is not necessary. For a week or ten days the sac gradually refills. Then it should begin to grow smaller. If it is excessively large at the end of a week, or if marked resorption is not apparent in ten to fourteen days, a secondary aspiration should be performed without injection.

The advantages of injection over any form of incision are manifest if only success may be anticipated. The failures are due to three causes—viz.:

1. Application of injection to cases incurable by this method, *i.e.*:
   - Symptomatic hydroceles
   - Spermatoceles, hematoceles and chyloceles
   - Hydroceles with inflamed, indurated, or calcareous walls
   - Hydroceles containing more than 150 c.c. (5 ounces)
2. Errors of technic, notably:
   - Incomplete evacuation. This is the most frequent cause of failure. To insure success the last drop must be squeezed from the vaginalis.
   - Injection of the carbolic acid into the cellular tissue. One need scarcely insist upon this point.
   - Failure to perform the secondary aspiration, which is sometimes part of the cure.
3. The use of iodin instead of carbolic acid. The iodin injection is painful and uncertain, while the carbolic acid, being a local anesthetic, produces only a momentary tingling and, at my hands, has been a certain cure.

Eversion of the Sac (Winckelman's Operation).—In order to perform this little operation neatly the incision in the skin must reach above the upper pole of the hydrocele and the dissection must begin at this point and be carried down upon the top of the sac until the cremaster muscle-fibers are recognized. The layer of cleavage between the sac and its fascial surroundings lies beneath the cremaster and this layer cannot be recognized in many instances over the center of the sac, for here the fascial layers are adherent from pressure and the cremaster so thinned out as to be unrecognizable.

At the upper pole, then, the cremaster is recognized and split. With the handle of the scalpel the cremaster is separated from the tunica vaginalis. If the hydrocele is not too large, it may thus be shelled out completely, and the testicle turned out of the scrotum. But large hydroceles become adherent, and about halfway down the front of the mass the tunic tears, its contents are evacuated, and the remainder of the dissection of the sac must be made with the sac empty.

When the sac is opened the character of its fluid must be noted. If it is clear like water or hazy, the sac is a spermatocele and must be excised entire. If the fluid is yellow true hydrocele is present; the superfluous portions of the sac are cut away and its edges, just beyond the epididymis, as well as the cord above the testicle, are turned inside out by loose catgut mattress-sutures, transfixing the cellular tissue behind the testicle. Special care must be taken to split the sac up to its very top, well above the testicle. Otherwise this eversion of the sac results in leaving a small pocket about the cord in which fluid will re-accumulate.

Andrews' operation, in which the upper end of the sac is opened and the rest turned inside out after the testicle has been fully freed from its fascial

attachments requires unnecessary dissection, but is the most foolproof operation for hydrocele in as much as it opens the sac at the very point where it must be turned inside out in order to prevent recurrence.

No drainage. The scrotum is to be well compressed.

EXCISION OF SPERMATOCELE

The sac is brought out through a longitudinal incision in the scrotum, and, if small, excised entire; if large, it must be incised, its contents evacuated, and its wall carefully removed. If any portion of the cyst wall is permitted to remain, the spermatocele is likely to recur. At the point of implantation of the epididymis, the cyst wall may have to be destroyed by a small point of cauterization.

EPIDIDYMOTOMY

The technic to be followed is that of Hagner. General anesthesia is preferable. I have only once operated without.

"At the juncture of the swollen epididymis and testicle, an incision 6 cm. to 10 cm. in length, depending upon the amount of enlargement, is made through the scrotum down to the tunica vaginalis, which is opened at the juncture of the epididymis and testicle. After the serous membrane is opened, all the fluid is evacuated and the enlarged epididymis examined through the wound. The testicle, with its adnexa, is delivered from the tunica vaginalis and enveloped in warm towels. The epididymis is then examined and multiple punctures made through its fibrous covering with a tenotome, especially over those portions where the enlargement and thickening are greatest. The knife is carried deep enough to penetrate the thickened fibrous capsule and enter the infiltrated connective tissue. When the knife is through the thickened covering of the epididymis, a very marked lessening of resistance will be felt. If pus be seen to escape from any of the punctures, the opening is enlarged and a small probe inserted in the direction from which the pus flows. By this method, I believe there is less danger of injuring the tubes of the epididymis than by cutting with the knife. After the probe is passed in, pus will be evacuated by light massage in the region of the abscess, and a fine-pointed syringe is used to wash out the cavity with 1:1,000 bichlorid of mercury, followed by physiological salt solution. The testicle is then restored to its normal position, and in every case the tunica vaginalis is thoroughly washed with 1:1,000 bichlorid, followed by normal salt solution. The incision of the tunica vaginalis is lightly closed with a running catgut suture; a cigarette drain of gauze is then laid over the incision, the skin being brought together with a subcutaneous silver wire suture, the cigarette drain passing out at the lower angle of the wound" (Hagner).

The drain is removed on the second day and the patient kept in bed for from three to five days thereafter. I have followed the above technic precisely, except that I use no antiseptic and prefer silkworm gut to silver wire.

If the abscess in the epididymis is large, it may be opened by a simple puncture through the adherent skin, but, unless fluctuation can be distinctly felt, it is difficult, by this blind operation, to strike the central suppurating point.

EPIDIDYMOVASOSTOMY

Anastomosis of the vas deferens to the epididymis is described as follows by its author, Edward Martin:

"Before the operation is undertaken, strictures, posturethral lesions, and chronic inflammation of the seminal vesicles and vas should be cured. The patency of the vas from the epididymis to the prostatic urethra should be assured by an injection into the lumen of the vas of a watery emulsion of inert pigment which, when passed with the urine or expressed by massage of the vasal ampulla, may be readily recognized. This preliminary operation may be accomplished under local anesthesia by means of either an ordinary hypodermic syringe, the needle of which is blunt, or the syringe used by oculists for washing out the lacrymal duct. The vas is held just beneath the skin by the fingers of an assistant; the line of incision is infiltrated; the vas is exposed, slit longitudinally, and from 20 to 30 drops of the injection are driven in. A large injection is likely to occasion severe pain at the base of the bladder (Belfield). If the pigment does not appear either in the urine, in the seminal discharge, or as the result of massage, anastomosis between the vas and epididymis will be futile.

"I believe it better to cut the vas obliquely, split it upward for a quarter of an inch and sew this wide-stretched lumen to the opening made, either in the epididymis, or, if spermatozoa are not found there, in the testicle. The microscopist should be at hand who examines the fluid which exudes from the epididymis when it is opened. This opening is made by the pinching up of a very small portion of it in a pair of conjunctival rat-toothed forceps and snipping this portion off by a pair of eye scissors curved on the flat. Usually a little blood and yellowish fluid will exude. This, taken up on a cover glass, will show innumerable spermatozoa. If spermatozoa are not present, other openings must be made into the epididymis or testicle until spermatozoa are found. The anastomosis between the cut ends of the vas and epididymis may be made by means of four sutures carried by fine curved eye-needles. Either silk or fine silver wires answer well. The suture is carried from without into the wall of the vas, and from within out of the wall of the epididymis. The tying down of the sutures completes the anastomosis. The approach to the epididymis and vas is made through the posterior scrotal wall. It usually does not require the application of a single ligature. The veins should be carefully avoided; otherwise troublesome and painful thrombosis will develop."

The last twenty years have made little improvement in the technic of this operation. Hagner, who has had relatively great success with it, believes that his success is due to using silver sutures to anastomose vas and epididymis. It is not impossible that these permanent sutures prevent stricture at the point of

anastomosis. Various attempts have been made at achieving the same end by threading a silver wire into the vas through the epididymis and out of the scrotum from which it is withdrawn after a week or so. The Hagner principle seems sounder.

EPIDIDYMECTOMY

The skin incision in the scrotum after circumcising any fistulæ that may exist is carried up over the anterior surface of the testicle and the tunica vaginalis opened. This will be found full of fluid or adherent. The outline of the epididymis is studied, the testicle palpated for masses of inflammation in this. If any considerable portion of the testicle is invaded it may seem wiser to perform orchidectomy.

The one delicate point in the operation is the avoidance of the vascular supply of the testicle which passes close to the *inner* side of the epididymis and may be involved in the infiltration about the globus major. Therefore in removing the epididymis one keeps very close to its inner side, especially near its head. The artery of the vas is inevitably divided. If necessary, part of the tunica albuginea is cut away with the epididymis and subsequently sutured with fine chromic gut. Doubtful indurated lesions in the testicle may be neglected. Even if they are tuberculous they will heal. After the whole epididymis has been freed with the adjoining portions of the vas this duct is cut and clamped and freed up into the upper part of the scrotum.

Cabot's technic is probably the most satisfactory for disposing of the vas. He passes the clamp on the lower end of the vas up into the inguinal canal until it reaches the region of the internal inguinal ring; there it is pushed upward and outward and the skin and superficial tissues incised over it. The vas is then picked up and, by means of a finger, inserted into the inguinal canal, freed into the pelvis as far as possible, where it is clamped, divided, cauterized with carbolic acid and dropped back. The groin wound is closed tight, the scrotal wound is drained, and an adhesive plaster bandage applied.

Evacuation of the Tuberculous Epididymis.—The testicle is delivered through the usual incision in the front of the scrotum, opening the tunica vaginalis. The extent of tuberculosis in epididymis and testicle and surrounding tissues is studied. As much of the epididymis as possible is removed. Abscesses are drained, fistulæ excised, the interior of abscesses curetted or touched with the cautery.

The testicle is then dropped back into the scrotum, no attention being paid to the open tunica vaginalis. The edges of the skin incision are sutured to the gutter of granulation tissue along the line of the epididymis, the greatest care being taken to prevent overlapping of the skin. The wider the incision is left open, the more rapid will be the healing, and the less tendency to sinus formation after operation. All sutures are of plain catgut.

The healing takes months. Light treatment or very light doses of x-ray

from time to time stimulate healing. At the end there may remain a fistula at the upper or lower end of the testicle. When the conclusion is reached that this will not improve, it should be excised. It is curious to note that though an ordinary clean epididymectomy, in the course of which the vas is dropped back into the scrotal wound, will result in fistula to the vas in a very large proportion of cases, yet these cases treated by drainage and excision of the small remaining fistulæ a year or so later have not given me any such trouble, though I have paid no attention to the vas.

ORCHIDECTOMY

Removal of the testicle is one of the simplest operations in the scrotum. It may almost always be performed under local anesthesia, and through an incision at the junction of the scrotum and groin. The operation is begun as though for varicocele, the spermatic cords picked up, the vein and the vas ligated separately, the testicle pulled out of its fascial bed in the scrotum, freed by a few strokes of the finger, its gubernaculum tied off, and the testicle removed. It is wise to insert a small counterdrain of rubber tissue at the bottom of the scrotum.

For Tuberculosis.—The vas should be treated as described in the preceding section.

For Tumor.—If the veins are infiltrated, these should be excised well up into the belly by opening the inguinal canal. Radiation is essential.

OPERATION FOR CRYPTORCHIDISM

An oblique inguinal incision is made as for the operation of hernia.

Regardless of whether the testicle is inside or outside of the canal the incision is carried to the external oblique which is exposed down to the external inguinal ring and opened as for hernia. The internal abdominal ring is exposed and enlarged by incision of the internal oblique and transversalis muscles in the line of their fibers.

The spermatic cord or hernial sac is then exposed by division of the fibers of the cremaster and lifted out of its bed. If the testicle lies in the inguinal canal or on the pubic bone its gubernaculum is clamped and cut and the rest of its attachments freed by blunt dissection. If the testicle lies within the abdomen it is not seen until after the hernial sac is opened.

If a hernial sac is not readily found this is carefully looked for at the upper end of the incision, between vas and veins, and when found is separated in the usual manner from the spermatic cord. If the testicle is in the abdomen it may be felt within the internal ring and pulled out by traction on the gubernaculum.

The testicle is carefully inspected and if anything suggesting teratoma is found about the hilum, the organ is sacrificed.

After separation of the spermatic cord from the hernial sac the testicle is

grasped in a pad of gauze and an effort is made to remove all the fascia and bits of cremaster from about the vessels and vas. If these tissues are well developed, the neatest procedure is to open each fascial compartment as though operating for varicocele or vasotomy, and having freed the vas with its vessels, and the pampiniform plexus, to separate these from their surrounding fascia, to divide the fascia and split it up over each vascular bundle thus freeing these immediately and completely. This procedure is most important and cannot always be done in this neat manner. Picking off tight bands of fascia here and there is the best we can do in many instances, and this process is not only slow, but also endangers the veins.

The testicle will now be found to have been loosened somewhat, but not quite sufficiently to permit it to lie loosely in the bottom of the scrotum. The testicle is once more held up and the finger passed along the vas, and later the vessels of the pampiniform plexus, up into the abdomen as high as it can reach, separating very gently the fascial sheath in which these structures lie. By this maneuver a very considerable additional length can be obtained, especially of the veins, and unless the testicle was actually at or near the internal abdominal ring, it will usually be found that the veins can be readily made much longer than the vas. If the vas still seems short this may be lengthened by nicking the fascia internal to the internal epigastric vessels, and slipping the testicle into the abdomen beneath the internal epigastric vessels and out again through the new hole. If, after every effort has been made, the pampiniform plexus still remains too short it must be cut, with the knowledge that atrophy of the testicle will result.

A bed is now made in the scrotum by inserting two fingers into this, and working a hole down to the very skin at the bottom-most part of this sac.

If the tunica vaginalis has not been opened and inverted in the course of the operation this is now done.

The scrotum is now turned inside out by the pressure of a finger at its base, and a chromic catgut suture caught through the skin at this point and then through the tunica albuginea of the testicle, and at a point near its lower pole. Before this suture is tied one observes carefully that there is no twist of the spermatic cord. The suture is then tied tightly, the scrotum pulled downward, and the testicle placed in its bottom. If there is any tension the testicle is steadied by a second suture over its upper end.

There is no need of any further traction. Sutures to the thigh, etc., do not hold the testicle in the scrotum unless it has been properly loosened from above, and if properly loosened it requires no traction.

The hernial sac is then tied off and the inguinal canal reconstructed as in the operation for hernia excepting that the cord is not transposed.

This operation should never be performed on children younger than five or six years of age. For bilateral abdominal cryptorchidism the operation should be postponed until after puberty and the testicles sacrificed.

CHAPTER LV

OPERATIONS UPON THE PENIS

INCISION OF THE FORESKIN FOR CHANCROID

This little operation is performed under infiltration anesthesia, particular care being taken to anesthetize the mucous membrane. A grooved director is then inserted under the foreskin (not in the urethra, if you please), and upon this the skin and mucous membrane are split with scissors from the free margin well back to the corona.

It is better practice to make two such incisions, one on each side of the penis, rather than to make a single dorsal incision, which does not thoroughly expose the pockets on each side of the frenum.

Do not suture, but apply argyrol crystals in the hope of preventing chancroidal inoculation of the wound.

CIRCUMCISION

Local Anesthesia.—The anesthetic solution is injected in a circle around the penis near its base, about 1 c.c. being injected on each side beneath Buck's fascia. This usually anesthetizes the whole surface, though additional infiltration into the mucosa near the corona may be required. If the prepuce cannot be retracted, a line of infiltration is made as far as possible within the mucous membrane on its dorsal aspect. This is then split up, the skin retracted, and the circle of infiltration completed.

The Operation.—Catch the prepuce at its mucocutaneous junction above and below with artery clamps, and draw it forward as far as possible.

Now apply the circumcision forceps—long-bladed straight forceps. They are to be clamped on the foreskin at an angle of 60 degrees with the long axis of the penis. The point of the forceps should be just behind the lower artery clamp, and great care should be employed not to include any of the glans penis in the grasp of the instrument (Fig. 153).

Cut away the redundant portion of the prepuce.

The forceps are now removed, and the skin slips back, exposing the connective tissue overlying the mucous membrane which adheres closely to the glans. This is to be slit down to the corona upon the dorsum and trimmed away on each side up to the frenum, leaving only enough tissue to hold the sutures. Old adhesions may be torn or cut away.

Ligate all bleeding points.

Catgut is the best material with which to suture the cut edges. The first suture should be applied at the raphé, then the others fall naturally in place. They should be applied very close together. Each one should take in the least possible portion of integument on the one side and of mucous membrane on the other.

The dressing is a narrow gauze strip well greased with sterile vaseline, and

FIG. 153.—METHOD OF APPLYING CIRCUMCISION FORCEPS.

covered with a loose piece of gauze, to be removed and replaced at each urination, held in place by a loose jock-strap.

After Treatment.—The patient need not be confined to bed.

The sutures begin to cut loose within a week. The wound is healed in two.

Complications.—Wound infections after circumcision notably by tuberculosis and syphilis, have attracted the attention of many authors, and have been illustrated by many curious cases. But, except after ritual circumcision, they are practically unknown nowadays, and present no special features. More remarkable is the occurrence of implantation cysts which has several times been noticed after this operation.

Hemorrhage is a common complication, the result of careless hemostasis.

AMPUTATION OF THE PENIS

General anesthesia is necessary. Ample skin-flaps (see p. 547) are then cut and dissected back a full inch.

Then the knife is inserted between the corpus spongiosum and the corpora cavernosa, and these bodies separated and amputated, the former being left 2 cm. longer than the latter. This step will be followed by violent hemorrhage from the corpora cavernosa. This is controlled by suturing the sheaths of the corpora to each other with chromic gut. Hemostasis having been thus effected, the urethra is split into two short flaps and these sutured with fine catgut to the skin. The wound is then dressed with the stump of the penis erect, and provision made for passage of the urine.

The wounds must be drained.

If the penis is to be amputated close to the pubes it is advisable to make a

small buttonhole in the perineum, through which the urethra is sutured to the skin.

Flaps.—A circular skin incision was used by early operators, but flap operations are now in vogue as giving more accurate apposition of the skin edges and cleaner healing. Senn and Jacobson both use long dorsal and short ventral flaps. Jacobson makes his so long that the urethra is sutured to a perforation in its lower part. Others prefer lateral flaps.

After Treatment.—If the flaps are cut long, erections need not be feared. A light dressing held snugly in place by adhesive plaster should prevent oozing. Frequent change of dressing is necessary to prevent defilement of the wound by urine. The patient should be examined repeatedly for stricture of the new meatus after healing is complete.

EXTIRPATION OF THE PENIS

With the patient in the lithotomy position an incision is made encircling the penis, dividing the scrotum, and extending in an inverted Y from the central point of the perineum toward each of the ischial tuberosities. Through this incision the perineum is first dissected so as to expose the urethra and the corpora cavernosa on each side of it. The bulb is divided at a point about 3 cm. anterior to the triangular ligament, and the corpus spongiosum dissected free down to that structure. Between the two corpora cavernosa this dissection exposes the two arteries of the corpora, and the dorsal arteries of the penis as well. These four vessels are ligated and the corpora cavernosa then cut away from the pubic rami. The perineal wound is then sutured, the end of the urethra split and attached to the skin, the patient's legs let down upon the table, and the incision carried up into each groin. The glands are then excised down to the saphenous opening on each side, and the bundle of fat, glands and penis taken away in one piece.

The testicles may be removed as well if the patient elects.

It is convenient in suturing the scrotum to take up part of the flaps by making a transverse suture of the central portion of the loose scrotal skin. The wounds are otherwise closed as they were made, with liberal drainage by rubber tissue.

CHAPTER LVI

DISEASES OF THE SCROTUM

ANOMALIES

The scrotum develops independently of the testicles, and if the latter fail to descend it remains rudimentary.

Failure of union between the lateral halves of the scrotum constitutes one of the features of pseudohermaphroditism.

CUTANEOUS DISEASES

The scrotum may be affected by most of the diseases of the skin. Only those that are modified by their position deserve notice.

Intertrigo.—Intertrigo, or chafing, occurs in children and in fat men. Much can be done to prevent it by cleanliness, talcum powder and the use of a suspensory bandage to keep the cutaneous surfaces apart. If the surface is moist and excoriated, it should be dusted with equal parts of finely powdered oxid of zinc, camphor, and starch, or it may be dressed with the oxid of zinc ointment or with a solution of sulphate of zinc. A strip of old thin linen should be used to sling up the scrotum and keep the cutaneous surfaces apart. Later, when the parts are dry, compound tincture of iodin, at first considerably diluted with water, locally, will hasten the cure.

Pityriasis.—In men with a delicate skin, especially in summer, there is often a slightly brown discoloration of the thigh and the scrotum, where the two surfaces lie habitually in contact, caused by a vegetable parasite in the upper layers of the epidermis. It sometimes gives rise to a mild local erythema and considerable itching. A few applications of the compound tincture of iodin diluted to half strength, and painted on after the affected skin has been washed with soap, to remove the fat from the scales and spores, and dried, will cure the discoloration and the itching. Sulphurous acid also does well.

Eczema Marginatum.—This is another parasitic disease, affecting the scrotum, thighs, mons veneris and buttocks. It is not an eczema, but a herpes tonsurans vesiculosus—a combination of herpes tonsurans and intertrigo. The eruption commences in one or more small, round patches, red, elevated and itchy, just where the scrotum habitually lies in contact with the thigh. It spreads circumferentially, healing in the center. The border of the eruption is sharply defined, and forms the distinctive feature of the disease. It is composed of papules, vesicles, excoriations and crusts. The parts within this festooned border

over which the disease has passed are left of a brown color. Little heaps of dried-up scales lie here and there upon this surface. Patches of eruption break out in the neighborhood or within the border, and behave exactly like the patches first constituting the disease. The affection is slow in getting well and tends to relapse. Among the scales scraped from the margin, the microscope may detect the moniliform filaments and spores of the tricophyton of Malmster. In chronic stages of the disease the parasite is difficult to find.

Treatment.—Dilute lead-water or oxid of zinc ointment may be used locally at first if there be much inflammation of the skin, to be followed by parasiticide lotions, or the latter may be commenced with at once. The best of these is a mild solution of corrosive sublimate, 1 :10,000, which should be kept constantly applied. Sulphurous acid, pure, is an excellent parasiticide; or compound resorcin ointment (N. F.). Treatment should be kept up for some time after apparent cure, as relapses are the rule, and can only be averted in this way.

Pediculi Pubis.—These parasites may be found upon the scrotum, as they may, in fact, upon any part of the body from which hairs grow. They exist in greatest abundance, however, about the genitals, and particularly on the mons veneris. They are plainly visible to the naked eye, as are their eggs attached to the hairs (Fig. 154). Mourson, a French naval surgeon, first pointed out the relation between certain blue spots on the skin and pediculi pubis.

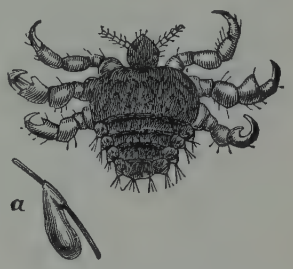

Fig. 154.—Pediculus.
a, Nit attached to hair.

Most physicians still employ the blue mercurial ointment, which may be rubbed into the hairy parts about the pubes and perineum and somewhat down the thighs, the patient going to bed in drawers and sleeping covered with the ointment all night. Two such applications, at a few days' interval, usually destroy the colony. The treatment is a very dirty one, and much soap and hot water form essential parts of it.

INJURIES OF THE SCROTUM

Wounds.—Wounds of the scrotum, whether surgical or accidental, give rise to free bleeding. This must be entirely controlled by ligature before the wound is sutured, for in the lax scrotal tissues an insignificant oozing may give rise to an enormous hematoma extending to penis and abdomen.

As a further precaution, the scrotum should be compressed beneath the adhesive plaster dressing described on p. 534.

Loss of Tissue.—When any considerable portion of the scrotum is destroyed by gangrene, accident, or the knife, the rapidity with which the defect covers in is little less than marvelous.

Castration need never be performed, however great the loss of integument. Kocher's case, in which both testicles were practically covered over by skin in

the short space of three weeks, shows what brilliant results may be obtained by expectant treatment. The surgeon need only help with aseptic dressings.

Hematoma and Hematocele.—Contusions of the scrotum give rise to extensive ecchymosis and edema quite comparable to the familiar black eye. If seen early the hemorrhage may be checked by adhesive plaster compression and an ice-cap. Later heat promotes absorption. The hematoma may have to be incised.

INFLAMMATIONS OF THE SCROTUM

Inflammatory Edema.—Extensive edema may complicate any inflammation of the scrotum on account of the laxity of its tissue.

Where edema is excessive, and the tension so great that injury to the skin seems imminent from pressure, a few punctures may be made on each side of the raphé, at the most dependent point of the scrotum. These punctures should be protected by a wet dressing to encourage oozing, to improve the circulation, and to prevent infection. In milder cases, a suspensory bandage will quickly reduce the edema, if the cause has been removed.

Cellulitis and Abscess.—Cellulitis and abscess of the scrotum are encountered clinically as furuncles or extensions of periurethral suppuration.

Erysipelas and Gangrene.—Erysipelas and fulminating gangrene of the scrotum and penis are apparently one and the same. Clinically the lesion begins as an erysipelatous dermatitis, which spreads, usually within twenty-four hours, over the whole of the external genitalia. The scrotum and penis are enormously swollen and tense. The temperature is not necessarily high, though there may be chills. By the second day gangrene has set in and this, too, spreads with great rapidity, the patient becomes toxic, and generally dies within a very few days.

The treatment is excision of the gangrenous tissue, and liberating incisions free enough to leave *no undermining whatever,* weak permanganate of potassium wet dressings, and general stimulation. With prompt surgery the patient's prospects are excellent. With incredible speed the small remnant of scrotum covers the nude testicles and healing is usually complete in about two months.

Scrotal Fistula and Calculi.—These are of urethral origin.

ELEPHANTIASIS, LYMPH SCROTUM, LYMPH VARIX

Elephantiasis is a chronic distention of the lymph-vessels, whereby the skin and subcutaneous tissues become thickened and indurated and the part often enlarges to an incredible size. It occurs usually in the lower extremities and in the penis and scrotum.

Etiology.—The cause of elephantiasis is obstruction of the lymph channels. Thus scrotal elephantiasis may follow extirpation of the inguinal glands. Severe chronic inguinal adenitis may have the same unhappy effect. But the enormous

elephantiasis, so frequent in the tropics, is due almost always to the *filaria sanguinis hominis.*

Born in some marsh or swamp, the worm enters a man's alimentary canal in a sip of water. Thence it makes it way to the lymphatics, where it settles down for life and attains its full development. Here it is impregnated and pours into the blood current an infinite stream of embryos. By night the blood is alive with them, by day not one can be found where, a few hours before, were myriads. Where they hide no one knows. But in the human host they cannot develop. To reach maturity they must be sucked up by a mosquito—a night-prowling insect. The mosquito, gorged with blood, returns to deposit her eggs and die in his, or rather her, native swamp, where from her corpse arise the worms ready to develop, to infest the water, and again to be swallowed by some unsuspecting man.

So much for the romance. The sorry fact is that these worms become impacted in the lymph glands or channels in such a way as slowly and progressively to obstruct the lymph flow. If this happens in the lower inguinal glands, elephantiasis of the lower extremity results; if in the upper chain, the scrotum and penis are affected; if in the iliac glands, *lymph varix* and *lymphadenoma* of the spermatic cord or *chyluria* may result.

Chyluria is caused by rupture of a dilated lymphatic vessel into the cavity of the lower ureter.

Symptoms.—Filarial elephantiasis begins with recurring attacks of dermatitis and edema accompanied by fever. At first, there is between the attacks only a brawny patch upon the skin and a slight enlargement of the inguinal glands. As the disease progresses, the skin and subcutaneous tissues become thickened by an overgrowth of dense fibrous elastic tissue, and the vessels, especially the lymphatics, become enormously dilated. As the scrotum enlarges it drags down the skin of pubes and perineum and inverts the skin of the penis, leaving, finally, no trace of that organ, except a transverse slit on the anterior surface of the tumor. This reaches incredible proportions. Wilkes removed a scrotum weighing 165 pounds, and Larrey mentions one weighing 200 pounds.

Treatment.—The *prophylaxis,* avoidance of unboiled drinking water in the tropics, need scarcely be insisted upon. *Curative* treatment is surgical. Fortunately, ablation of the hypertrophied tissues is rarely followed by recurrence, though such an operation does not pretend to affect the mother worm or her ovulation. The chief danger of operation is the bleeding. It is essential to remove as much as possible of the indurated tissue, and yet to leave flaps to cover the testicles and penis. Radical cure of hernia may also be required. The strictest asepsis should be observed to avoid infection with lymphatic absorption.

Chyluria has been attacked by denuding the ureter of the adherent lymphatic tissue. The whole ureter has been thus denuded in two operations and with cessation of the chyluria thereafter. But one would fear subsequent nutritional changes in the ureter wall.

TUMORS OF THE SCROTUM

Cysts.—Small sebaceous cysts, shining white through the distended skin, occur on any part of the scrotum, but particularly on the raphé. They sometimes attain startling dimensions. Echinococcus cysts have been met with. A urinary pocket opening into the urethra behind a stricture has been mistaken for hydrocele. Jacobson gives a detailed account of two cases of cystic disease of the scrotum, to which Tilden Brown[1] has added a third.

FIG. 155.—SCROTAL EPITHELIOMA.

Multiple minute blood-cysts, varying in size up to that of a large pinhead, and sprinkled abundantly over the entire scrotum, are sometimes found after middle life. They are of a dark-blue color and give rise to no changes in the skin and to no symptoms whatsoever, excepting their appearance, which annoys the patient. They may be cured permanently by touching each one separately with an electrocautery, or pricking it and touching the raw surface with a nitrate of silver point.

Cases of *angioma, angiokeratoma, fibroma, lipoma, fibromyxoma, osteochondroma* and *sarcoma* have been reported.

Epithelioma of the Scrotum (Chimney Sweeps' Cancer).—Soot seems to be the exciting cause of scrotal epithelioma (Fig. 155) in England, although in

[1] *J. Cutan. & Genito-Urin. Dis.*, 1895, xiii, 33.

other countries those whose occupation brings them into contact with this substance do not seem to suffer. I have seen but five cases.

The disease begins as one or more small, soft warts or tubercles, usually at the lower forepart of the scrotum. These remain unchanged for a time, but finally indurate slightly, become excoriated, scab over and ulcerate, the ulcer extending backward and destroying, with more or less rapidity, the whole scrotum. The ulcer has hardened, irregular, purplish, everted, knotty borders; a hard, uneven, unhealthy looking base.

Exceptionally the warty growth develops into a large cauliflower-like mass.

Death occurs by exhaustion, or by hemorrhage, if a large vessel be severed by the advancing ulceration. The disease continues local for some time. It is only tardily that the inguinal glands become involved.

The diagnosis may be made by biopsy.

The lesions are readily excised and the scrotal skin reacts acutely to radiation. Hence the usual procedure is to excise three weeks after a single radiation. Small tumors may be conveniently destroyed by the implantation of radium seeds.

CHAPTER LVII

THE TESTICLE: ATROPHY; TORSION

The two constituent parts of the testicle are developed separately in the fetus. The epididymis is formed from the lower part of the wolffian body, and its duct is a continuation of the wolffian duct to the lower and back part of the bladder. Thus the epididymis may be regarded embryologically as the lower part of the kidney. As such Belfield believes it a secretory organ and as liable to hematogenous infections, notably primary tuberculosis, as the kidney. The secreting portion of the testicle, on the other hand, is formed from fetal tissue lying in front of, but seemingly independent of, the wolffian body.

The Descent of the Testicle.—The testicle develops in front of the wolffian body, resting upon the brim of the true pelvis near the site of the future inguinal canal, which, at the period of the fifth month, is represented by the *processus funiculovaginalis,* a pouch of peritoneum running into and terminating among the muscle-fibers of the abdominal wall, through which it ultimately extends into the scrotum. This pouch offers a resting place into which the testis tends to work its way, aided by the *gubernaculum testis,* a fibromuscular cord attached above to the testis, epididymis and spermatic cord, below to the abdominal wall, the inner surface of the pubes, the bottom of the scrotum, the perineum and by a few fibers to the thigh over the saphenous opening. Guided, or perhaps pulled, by the gubernaculum (a point which is disputed), the testicle settles into the peritoneal pouch, and with it sinks gradually through the abdominal wall and into the scrotum. The stronger fibers of the gubernaculum, fastened to the bottom of the scrotum, persist in adult life as a fascial band, while the processus funiculovaginalis, inverted by the descent of the testis, becomes the tunica vaginalis. The part of the processus above the testis is obliterated by adhesion of its opposed surfaces, beginning at both ends, above at the internal abdominal ring, below quite near the testicle. When adhesion is complete only a fibrous cord, the *habenula,* remains.

The descent of the testicle into the scrotum occurs during the last six months of intra-uterine life. Indeed, in 10 per cent or 20 per cent of all children the testicles are still in the abdomen at the time of birth. Most of these testicles descend during the following weeks, but a small proportion are retained for years, or even permanently. The clinician need take no account of the position of the testicle during the first year because at that time it exhibits a very decided mobility, but if it is retained for longer than this the condition is definitely abnormal.

ANOMALIES OF THE TESTICLE

Monod and Terrillon's classification of anomalies of the testicle is the following:

- Anomalies in development
  - In number
    - In excess — Polyorchism
    - Deficient
      - Absence — Anorchism
      - Fusion — Synorchism
  - In size
    - In excess — Hypertrophy
    - Deficient — Atrophy
- Anomalies in migration
  - Undescended
    - Incomplete migration — Retention
    - Abnormal migration — Ectopia
  - Descended — Inversion

Polyorchism.—Though many instances of supernumerary testis have been reported, and the condition is known to exist in the lower animals, the alleged instances in man have proved to be pedunculated tumors, encysted hydrocele, omental hernia, or have lacked the proof of a pathological examination, with the exception of the case reported by Arbuthnot Lane,[1] in which the diagnosis was confirmed by a microscopical examination of the supernumerary organ.

Anorchism.—The testicle may be lacking on one or both sides. With absence of the testicle is associated: (1) Usually absence of the epididymis and part of the vas, or (2) exceptionally, entire absence of the seminal duct up to the vesicle, or (3) still more rarely, the testis only is wanting, while (4) the testis may be present and the vesicle, epididymis and vas absent.

During life anorchism cannot be differentiated from abdominal cryptorchism, except by operation. I have never seen a case.

Synorchism.—Jacobson cites the cases of Cruveilhier and Lockwood, the one in an adult, the other in a fetus, of intra-abdominal testicular fusion.

Cryptorchism.—Cryptorchism means absence of one or both testicles from the scrotum, and their presence elsewhere, in contradistinction to *anorchism,* meaning total absence. *Monorchism* is unilateral cryptorchism. A *retained testis* is one that has been arrested at some point in its normal descent. An *ectopic testis* is, strictly speaking, one that has lodged at some point out of its normal course. The term "ectopia testis" is often used loosely as a synonym for cryptorchism.

Cryptorchism is an infrequent anomaly. Eccles reports 854 cases among 48,000 men with hernia, Coley, 737 among 59,235. Marshall found eleven cases among 10,800 recruits.

By obstruction to its progress or by traction from behind, due to peritoneal adhesions, the testis may be retained inside the abdomen, or it may be arrested at any point in its descent. Hence there may be: (1) *Abdominal retention,* the testis floating attached by a "mesorchium," or resting in the false pelvis near

[1] *Brit. M. J.,* 1894, ii, 1241.

the internal abdominal ring. (2) *Inguinal retention,* a more common variety, the testis lying in the inguinal canal. (3) *Puboscrotal retention,* the testis lying in the groin, at or near the external inguinal ring, or retracted outward over the external oblique aponeurosis. (4) Rarely the testicle alone is retained, while the epididymis and vas are separated from it and descend normally into the scrotum.

The position of the retained organ is only relatively fixed. It has a certain range of motion, sometimes so great as to leave the classification doubtful. A

FIG. 156.—CRYPTORCHIDISM.

severe strain may cause retraction into the inguinal canal of a testicle that had been supposed to be normal.

Ectopia.—Abnormal tension of some of the accessory bands of the gubernaculum may drag the testis out of its normal course: (1) Into the perineum,[2] where it lies beneath the deep fascia, in front of the anus (among Coley's 737 cases only fifteen were perineal); or (2) through the crural canal to the saphenous opening, which is very rare; or (3) into the opposite side of the scrotum, as in the cases of Jordan[3] and von Lenhossek; or (4) to the front of the pubis at the base of the penis in the two cases of Popow.[4]

[2] *Cf.* Loewe, *J. Am. M. Ass.,* 1915, lxv, No. 14.
[3] *Deutsch. med. Wchnschr.,* 1895, xxi, 525.
[4] *Bull. Soc. anat.,* 1888, v, ii, 653.

Inversion.—The testicle may be turned upside down in the scrotum, or rotated so that its long axis is horizontal or abnormally attached to the epididymis. The only clinical significance of these rare anomalies is their bearing on puncture of hydrocele, for the inverted testis may lie above and in front of instead of below and behind the tunica vaginalis.

The internal secretory function of the gland, commonly attributed to the interstitial cells, is often not interfered with. It will be noted, however, that the reason why the majority of cryptorchids have general masculine characteristics is because that majority has its testicles retained under the skin of the groin, but outside of the inguinal canal. Those whose testicles are both retained in the canal or in the abdomen are usually of the eunuchoid type. The retained testicle is relatively small.

Since the discovery that spermatogenesis occurs in those rodents that have facultative scrotal testicles only when these glands are in the scrotum it is believed that the loss of the spermatogenetic function in the retained testicle is due, as in these rodents, to the increased temperature at which the glands subsist in the abdomen as compared to that in the scrotum.

But whether the cause be pressure or heat, the retained testicle is always sterile, sometimes deficient in internal secretion, usually small, often associated with deformities of the epididymis. Milner Smyth has added one to Curling's classical group of cryptorchids in children and Beigel found numerous spermatozoa in the semen of a double cryptorchid aged twenty-two.

A great majority of double cryptorchids are sterile, and so general is the application of this rule that Curling, after citing several cases of women married to cryptorchids bearing one or several children, felt compelled to doubt the paternity. But several similar cases have been reported since, a notable one by Milner Smyth,[5] whose patient begot five children, and the question is seemingly closed by the observations of Beigel[6] and of Valette. The former found numerous spermatozoa in the semen of a double cryptorchid aged twenty-two. The latter found a few in the retained testicle removed from a man twenty-one years old.

In determining the sterility of any given patient several points must be taken into consideration.

1. The position of the testicles, since all abdominal cryptorchids appear to be sterile.

2. Freedom from previous or present inflammation.

3. The size, consistence, sensitiveness, motility and abnormality of the testicle, and

4. The age of the patient. All the cryptorchids to whom children have been attributed were young men. The period of possible paternity is apparently not over five or ten years.

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[5] *Lancet*, 1899, ii, 785.

[6] *Virchow's Arch.*, 1867, xxxviii, 144. *Cf.* also Schmidt. *Beitr. z. klin. Chir.*, 1912, lxxxii, 36.

5. A definite conclusion is arrived at from the microscopic examination of the semen for spermatozoa.

Complications of Cryptorchism.—*Pain* in the testicle is an early evidence that the surrounding muscles are exerting injurious pressure upon the gland. *Inflammation,* whether traumatic or gonorrheal, is not rare, and, if acute, is exquisitely painful. *Atrophy* follows. Hydrocele, gangrene, abscess and fatal peritonitis are among the rarer consequences of inflammation of the testicle.

Hernia, actual or potential, always accompanies inguinal retention, since the testicle keeps the canal patent. *Torsion of the cord* occurs almost exclusively in malposed testicles.

Malignant growths affect the retained as they do the descended testicle. The tradition that the retained testis is peculiarly liable to cancer was first disputed by Eccles. Buckley [7] states that:

"About one in four cases of malignant abnormally situated testicles is found within the abdomen; one malignant abdominal testicle occurs to each fifteen malignant scrotal testicles; about one in each seventy-five abdominally retained testes will become malignant."

Dean's statistics suggest that the retained testicle is two hundred times as liable to malignant disease as is the normal one.

Diagnosis.—It is not uncommon for testicles retained at or about the external ring during the first year or two of life, to descend subsequently to a seemingly normal position in the scrotum. Thereafter they are under poor control by the gubernaculum and readily retracted into the groin. Such testicles are very liable to torsion and atrophy and should therefore not be regarded as in a satisfactory condition.

But in as much as the satisfactory descent of the testicle is altogether unusual after the fourth or fifth year of age, no serious accounts need be taken of the position of the testicle until the child reaches the age of five or six, when the physical battle of life begins, unless an associated hernia requires operation. Ambrose Paré has left an amusing account of one Marie Germain who jumped a ditch in chasing her pigs when, feeling a sharp pain and "seeing her genitals develop," *"s'en retourne larmoyante en la maison de sa mère disant que ses tripes lui estoient sorties hors du ventre,"* whereupon her true sex was recognized and she became a man.

Prognosis.—The malformation usually affects the processus as well as the testicle. Even though the range of mobility of the testicle does not invade the inguinal canal operation almost always reveals an open peritoneal process well down the canal, perhaps even to the testicle. If not operated upon, therefore, hernia may be regarded as inevitable. The abdominal testicle is of no value after puberty and is singularly liable to tumor, the inguinal testicle may still produce spermatozoa and is only in danger of torsion. Either will atrophy if not brought down into the scrotum.

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[7] *Surg., Gynec. & Obst.,* 1913, xxii, 704.

Treatment.—During infancy the treatment is by truss if there is hernia. The customary advice to attempt to draw down the testicle by the use of a pad seems to be purely theoretical.

The suggestion of Armstrong, a school-teacher, that up to thirteen years of age three out of four cryptorchids can be relieved by the administration of thyroid extract is interesting but lacks confirmation.

In fact, the testicle had best be let alone until the parents are ready to permit the child to be operated upon.

The advice to be given is that an expert may operate upon a child five or six years of age, that the child's prospect of masculine development and fertility are much better if the operation is performed while he is young and likely to be seriously impaired if it is delayed after the tenth or twelfth year.

Bland Sutton was opposed to operation on the ground that fertility was generally interfered with by the associated atresia of the epididymis. No statistics have been kept of a sufficient number of individuals after operation to controvert this theory. But in addition to these questions of sex, there is the necessity for operation in order to prevent hernia and to forestall torsion.

Let it be noted that whether the described technic for operation is followed or not, the anchoring of the relatively normal testicle to the bottom of the scrotum is just as important a part of the operation as the pulling down from the groin of its more diseased fellow.

TORSION OF THE SPERMATIC CORD AND GANGRENE OF THE TESTICLE

Torsion of the cord occurs only in individuals who are predisposed to this accident through lack of a gubernaculum sufficiently stout to prevent muscular contraction of the cremaster from twisting the testicle. The predisposing cause is therefore maldescent of the testicle. The patient suffering from torsion of the cord not infrequently gives a history of previous undue retractability of the testicle into the groin or shows cryptorchism of the opposite testicle.

The actuating cause is a strain, such as lifting a heavy object or some gymnastic effort which, by exciting a violent contraction of the cremaster, imparts to the abnormally loose testicle a turn of at least 90 degrees. (Fig. 157). The torsion rarely occurs in young children. I have seen some ten cases of torsion at Bellevue Hospital, all of them between the ages of fifteen and twenty-five. In private practice I have seen but four cases. Doubtless the excessive muscular strains to which the working class are subjected are usually the exciting cause of torsion.

Pathology.—The torsion occurs immediately above the epididymis.

If the torsion is slight, a sharp pain is felt in the testicle radiating to the groin. The patient instinctively compresses the painful spot and may accidentally reduce the torsion. Even if he consults a physician, the accident is likely to remain unexplained and the slight torsion to recur. Van der Poel reported a history of a patient who had had a number of attacks and had learned how to

untwist the testicle and relieve the pain. I have met two such patients; one of them had atrophy of the testicle, the other did not.

It is not impossible that the atrophy of the testicle which is attributed to such inadequate reasons as sitting on a cold stone, etc., is actually due to slight unrelieved torsion of the cord, leading to permanent restriction of the arterial circulation.

The more familiar type of torsion results in immediate and complete obstruction of the circulation. The testicle becomes gangrenous. The tunica vaginalis contains a small amount of bloody fluid. If operation is not immediately performed, there ensues an inflammatory reaction of the surrounding connective tissue. If the condition is still further neglected, it will terminate either in suppuration, sinus formation and evacuation of the tubules of the testicle or in atrophy of the organ.

FIG. 157.—TORSION OF TESTICLE. (Campbell)

Symptoms.—The condition presents itself under several types: (1) The milder attacks of slight torsion, which may spontaneously untwist or may be untwisted by the patient, may occur once or a number of times and may or may not result in atrophy of the testicle, for a clinical class by themselves. (2) The ectopic testicle that becomes twisted in the groin or in the inguinal canal gives symptoms so closely resembling strangulated hernia that the two may be confused. There is intense pain. There is inflammatory swelling. There is perhaps a hernia associated with the cryptorchism. The relative intoxication in propor-

tion to the pain is said to be less with torsion than with strangulation of the gut. More or less fever, edema and tenderness accompany each and, since the treatment is operation for both conditions, there is no reason to delay too long in fanciful clinical distinctions unless palpation of the mass reveals the true condition. (3) The scrotal testicle at first presents an appearance suggesting a hyperacute epididymitis. The testicle is exquisitely sensitive and enveloped in edematous connective tissue so that the distinction between testicle and epididymis cannot be palpated. There is not much hydrocele.

If the patient is not seen until several days have elapsed, the pain will have subsided and the patient will be left with a hard mass suggesting neoplasm rather than infection. After a week or so of this condition, the testicle is likely to suppurate but may merely atrophy.

Diagnosis.—Torsion should be suspected as the cause of all fugitive attacks of orchitis or sudden testicular pain. The history of previous mobility in the testicle may help determine this point. Marked movement in the opposite testicle suggests a possibility of torsion.

Acute torsion is not very hard to diagnose but it is seen so rarely that the possibility of torsion is simply overlooked. The acute attack is accompanied by such severe pain as to demand operation in any case and then the diagnosis is made as soon as the tunica vaginalis is opened by the bloody fluid found therein and the gangrenous testicle thus exposed.

Treatment.—Nash is the only physician to have untwisted a torsion. The torsion had existed for an hour and a half, atrophy ensued.

The treatment of torsion is orchidectomy. Operative untwisting has not been successful. No mortality has been reported from the operation.

If the opposite testicle is also mobile, advantage should be taken of the anesthesia to fasten this testicle to the bottom of the scrotum by a single suture.

INJURY TO THE SPERMATIC CORD

While such injuries to the spermatic cord as totally shut off the blood supply of the testicle are calculated to cause gangrene of the organ, the impunity with which the cord may be tied off is exemplified by numerous cases collected by Mauclaire. This operation is, apparently, almost always followed by atrophy of the testicle, for the blood supply to the testicle from the surrounding fascia furnishes sufficient nutrition to prevent gangrene.

CHAPTER LVIII

INFLAMMATIONS OF THE TESTICLE AND EPIDIDYMIS

Etiology.—Inflammations of the testicle may arise by:

1. Infection passing along the seminal canals from the urethra
2. Infection from the blood or the lymph
3. Trauma

1. To the first class belong simple inflammatory and gonorrheal infections; they usually involve the epididymis only. Tuberculosis probably belongs here, though it attacks the testis secondarily.

2. To the second class belong syphilitic inflammations, usually beginning in the testicle, and the orchitis of infectious diseases.

3. Inflammations of the third class (traumatic) implicate both testis and epididymis, but chiefly the former.

EPIDIDYMITIS

Epididymitis is the most common of all the diseases of the testicle. It occurs at any age, most frequently during early adult life and middle age, since its chief cause—urethral inflammation or irritation—exists most commonly during these periods of life. It is usually acute, but may be subacute from the first. It habitually terminates in resolution, rarely in abscess. One attack predisposes to another. It is often double, but the inflammation of one testicle usually precedes that of the other. Relapse is not uncommon.

Etiology

The prime cause of epididymitis is inflammation of the internal genitals. The inflammation travels from the urethra up the ejaculatory duct and along the vas deferens by extension of the inflammation along the lymphatics of these canals. This explanation has been disputed, but three facts prove it:

1. No matter what the condition of the anterior urethra, epididymitis never occurs except from inflammation or trauma of the posterior urethra.

2. The prodromal symptoms often point to inflammation of the vas before there is inflammation of the epididymis.

3. Vasotomy usually prevents relapsing epididymitis.

Gonorrhea.—Epididymitis is to be looked for mainly from the third to the eighth week of gonorrhea. A number of cases are on record in which it is

alleged that epididymitis has preceded the gonorrheal outbreak. Such an occurrence can only be explained by the existence of antecedent posterior urethritis or spermatocystitis.

Some individuals seem predisposed to epididymitis, so that, notwithstanding the utmost care, every attack of gonorrhea is invariably attended by swelled testicles; while others, regardless of all hygienic precautions, go about with a raging gonorrhea, employing no treatment, continuing sexual intercourse and the abuse of alcohol, not even supporting the testicles, and yet escape. Indeed, the one patient who took more scrupulous care of himself than any other in my whole experience, who went to bed and stayed there, took no local treatment whatever, and lived on the lightest of diets, in due time developed a double epididymitis, which terminated in suppuration on both sides. He was sixteen, wealthy, unimmunized.

It may, however, be stated dogmatically that while a gonorrhea of itself will sometimes, in spite of all precautions, occasion swelled testicles, yet this complication is not likely to ensue if the patient wear a suspensory bandage, abstain from violent or jolting exercise, such as horseback riding, dancing, as well as sexual excitement and the use of alcohol. The passage of instruments through a canal subject at the time to gonorrhea is a sufficient cause for epididymitis. The local, and especially the abortive, methods of treatment are, therefore, peculiarly liable to occasion swelled testicle. Yet the modern, moderate local treatment, if promptly applied and properly administered, is the one way to prevent posterior urethritis, epididymitis, and all the other complications of gonorrhea.

Non-gonorrheal Infection.—The peculiar characteristics of non-gonorrheal epididymitis occurring in the course of stricture and prostatism have long been recognized. But it is not well known that non-urethral prostatitis and vesiculitis are as often complicated with epididymitis as are the gonorrheal inflammations of these organs.

Pathology

Gonorrheal Infection.—Typical gonorrheal epididymitis begins in the globus minor as an acute inflammation that always proceeds to the formation of pus, but the foci, though multiple, rarely contain more than a drop of pus. If mild the infection remains confined to this end of the epididymis. If severe it extends throughout the organ, producing similar miliary abscesses at various points, while the whole epididymis becomes infiltrated, swollen and red. *The testicle takes no part in the inflammation,* but the tunica vaginalis is acutely inflamed, and hydrocele may result. The hyperacute case combines an intensely swollen epididymis, an acute hydrocele, and considerable edema of the cellular tissue about the testicle so that this feels like an evenly swollen hard sensitive mass. The vas deferens may share in the inflammation to the extent of a sensitiveness and slight thickening; but the deferentitis does not show the virulence characteristic of non-gonorrheal infection.

Non-gonorrheal Infection.—Infection with bacteria other than the gonococcus may occur during a gonorrhea. Indeed in as much as smears and cultures are often negative it is difficult to distinguish the limitations of the

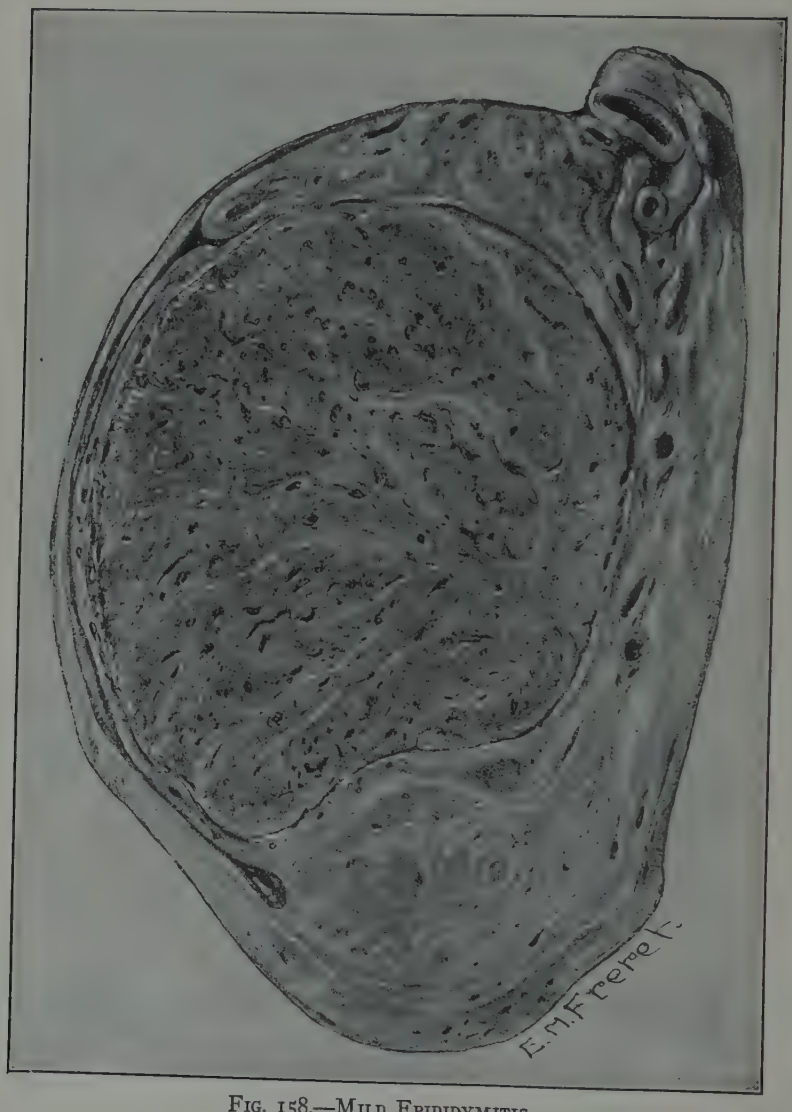


FIG. 158.—MILD EPIDIDYMITIS.

Multiple foci of suppuration in globus minor. The organ was removed under a mistaken diagnosis of tuberculosis.

two types of inflammation. The typical non-gonorrheal case follows one of three types:

1. The pseudotuberculous type. The inflammation begins, often in a patient with no history of antecedent urethral lesion, as a chronic inflammatory nodule

in the globus minor, but slightly tender and causing no constitutional disturbance. It passes for tuberculosis until, quite spontaneously, it disappears, leaving a scarcely perceptible thickening of the epididymis.

2. The inflammation begins, not in the epididymis at all, but in the seminal vesicle and vas deferens. There may be stricture, prostatism, chronic posterior urethritis or the infection may begin independently of any known preceding lesion. At the outset the vesicle becomes, not only large, but finally of a wooden hardness and much thickened. There may be abscesses in the vesicle or in the adjacent prostatic lateral lobe, but these are uncommon; the vesicle usually feels about the size of the little finger, and it is not very sensitive. From the vesicle, the inflammation advances along the vas as a perideferentitis, the whole cord becomes thick, sensitive, adherent. It usually reaches the size of a lead pencil and may be twice as large. The progress of the inflammation may sometimes be followed day by day as it advances down the vas toward the epididymis. The tendency of this infection is to result in abscess either in the epididymis or at the external abdominal ring.

3. The infection shows itself as an acute epididymitis similar to that due to gonorrhea.

The Decline.—The gonorrheal and non-gonorrheal infections differ in their decline. The former, however acute, and although they always lead to miliary abscesses in the epididymis, very rarely terminate in gross suppuration. Expectant treatment will almost always promptly cure them. Within a few weeks the major part of the edema is absorbed, and there remains only a knot of scar at a point where the suppuration has been.

But the termination of non-gonococcic infection is much more grave. Fortunately abscess within the pelvis is rare. But abscess of the vas in the upper part of the scrotum, and abscess in the globus minor of the epididymis, are both common terminations. If gross suppuration does not occur the infection may hang on for an indefinite period, and if it finally does terminate without suppuration relapses are extremely common as compared to their infrequency in truly gonorrheal infection, unless the patient acquires a new gonorrhea.

Rare Types of Infection.—I have twice seen a truly fulminating epididymitis. Operation revealed miliary abscesses throughout the epididymis, and resulting gangrene of the testicle requiring orchidectomy. *B. coli* was revealed by culture.

Symptoms

Gonorrheal.—Usually the urethral discharge is not visibly modified until after the epididymis begins to swell. Then it diminishes, perhaps stops, to return again as soon as the inflammation of the epididymis is fairly on the decline.

A vague uneasiness is sometimes felt in the testicle and along the cord up into the back, as if the cord were being pulled down. Attentive patients will frequently aver that the pain was noticeable in the groin for some hours before any uneasiness was experienced in the testicle.

The attack then begins with pain and swelling of the epididymis. In the *subacute* form, the swelling is moderate, comes on rather slowly, and is confined to the epididymis. There is but little, if any, fluid in the tunica vaginalis. There are no constitutional symptoms and the pain is not excruciating. It is aggravated by the erect posture, but wholly disappears when the patient is put on his back with the testicle elevated.

But the picture is a different one if the onset is *acute*. The swelling commences promptly and increases with rapidity. Within a few hours the testicle is swallowed up in the exquisite tension and tenderness of hyperacute epididymitis and vaginalitis. The scrotal tissues become edematous. The inflamed mass rapidly reaches the size of the fist. The cord may or may not share in the infection.

Non-gonorrheal.—One must distinguish the case in which the epididymitis predominates from that in which the deferentitis predominates. The former, if acute, resembles gonorrheal epididymitis but often terminates in gross suppuration resulting in an abscess which fills the scrotum. These cases should be operated upon just as soon as it is evident that palliative treatment is not going to control them.

The subacute cases of the epididymal type may simulate tuberculosis of the epididymis very closely. The patient has no gonorrhea, and there is often no very grave lesion in the prostate or seminal vesicles, though these organs contain pus. It is likely after a few weeks to recede spontaneously and leave but a very small scar to mark its passage.

The type of epididymitis in which inflammation of the vas predominates is described above.

Chronic and Relapsing Epididymitis.—Any of the acute types of epididymitis described above may dwindle off gradually into a chronic condition, usually with an irregular tendency to relapse. The relapses may occur in an epididymis which is constantly a little full and tender or after the original inflammation has apparently subsided. Gonococcic epididymitis is only likely to relapse if a new infection of gonorrhea occurs; indeed, unlike gonorrheal rheumatism, many a person has an epididymitis during one attack of gonorrhea, and none during subsequent attacks. But non-gonorrheal epididymitis is peculiarly subject to relapses without rhyme or reason in some instances. Relapses are habitually milder, but more long drawn out than the first attack.

Diagnosis

The diagnosis between the gonococcic, the non-gonococcic and the tuberculous epididymitis is by no means always easy until the condition has existed for some time. *The only way to distinguish the non-gonococcic pseudotuberculosis of the epididymis in certain cases is to wait.*

A positive complement fixation test for gonorrhea does not prove that an epididymitis is wholly due to the gonococcus; the distinction is perhaps unim-

portant, yet I fancy that certain cases, occurring during a gonorrhea, and with a complement fixation test positive, are due to a mixed infection and that this accounts for the certain cases of marked deferentitis and of suppuration following a gonorrheal epididymitis.

Acute orchitis is distinguished by its etiology, the more marked general symptoms, and the fact that the testis proper, and not the epididymis, is chiefly involved.

Prognosis

As the disease advances, pain increases in intensity. The duration of pain and swelling depend almost exclusively on the treatment. This should control fever and pain immediately. The swelling subsides more slowly.

The gradual disappearance of the hardness from the epididymis may extend over many months, and in most cases is never entirely accomplished. The point first attacked is the last to resolve. The absorption starts rapidly, but progresses more and more slowly, until it seems to remain stationary. The little hard lump in the epididymis occasions the patient no uneasiness, is not sensitive to pressure, and is ignored. Extensive *suppuration* is rare in gonorrheal epididymitis, but not uncommon in severe cases due to other bacteria. *Atrophy of the testicle* never results.

The prognosis may be summed up thus: there is no danger to life, to sexual potency, or to desire. Neuralgia or tuberculosis may follow acute epididymitis. Sterility, of the affected organ, and relapse are both possible results, but the former is not inevitable; the latter is uncommon.

Yet the patient is not impotent, his sexual power and appetite are unimpaired. He ejaculates semen resembling the healthy fluid in quantity, smell, and color, but containing no spermatozoa.

Benzler's [1] investigations are interesting in this regard. By looking up the subsequent history of old soldiers who had had gonorrhea while in the German army, he found that among those who had been married three or more years, 10.5 per cent of those who had suffered gonorrhea without epididymitis were childless, as were 23.4 per cent of those who had had single epididymitis and 41.7 per cent of those who had had both organs inflamed.

Treatment

Prophylaxis.—The prevention of epididymitis during the treatment of an inflamed urethra is compassed by means of gentleness. It is impossible to lay down a fixed rule by which this complication may always be avoided. Even the rough passage of sounds through an inflamed urethra does not always cause it, while it may be excited by the gentlest of injections.

During acute gonorrhea it is customary to instruct the patient to wear a

[1] *Arch. f. Dermat. u. Syph.*, 1898, xlv, 33.

suspensory bandage, and to avoid all sexual and physical exercise, and this measure certainly reduces the danger of epididymitis.

Treatment of Gonorrheal Epididymitis.—The treatment consists of rest in bed, immobilization of the testicle and local applications.

Rest in Bed.—Although the mildest cases do not always require rest, one can never be sure whether the case will remain mild or whether it will go on to acute inflammation. Whenever this is possible, rest in bed is therefore required.

Immobilization of the Testicle.—Proper immobilization of the testicle is the most essential element in the treatment of epididymitis. Immobilization, not merely elevation. No bandage bought in a shop will accomplish this immobilization. Inefficient immobilization may suffice for mild cases. Satisfactory immobilization can only be obtained by adhesive plaster. The essential features of the bandage are the following:

1. A piece of adhesive plaster at least three inches broad, and with its middle portion protected so that it will not adhere to the scrotum, is passed from one iliac crest to the other (its center crossing the anterior iliac spine) beneath the scrotum which it elevates as high as possible.

2. From the center of this two back straps are passed around the thighs in the gluteal folds, crossing straps No. 1 at the anterior superior spine of the ilium. (Figs. 159, A, B.)

3. The bandage is steadied by further adhesive straps across the front of the scrotum and abdomen. (Fig. 159, C, D.)

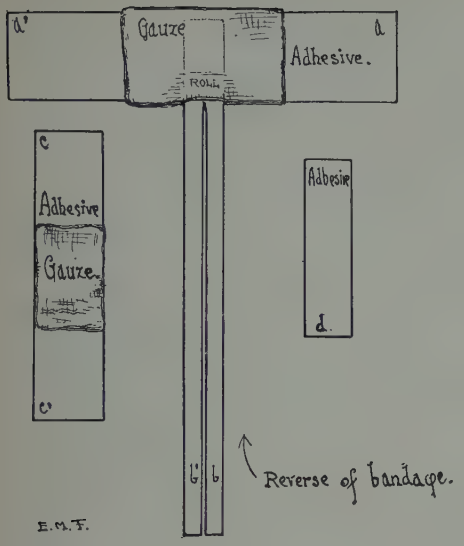
If the patient is not well in three or four days after the application of this bandage, it is usually wise to operate; otherwise the inflammation will be a tedious one, very possibly complicated by suppuration, and almost certainly by considerable inflammation of the vas deferens.

This bandage may be manufactured out of canton flannel bandages instead of adhesive plaster. It is, of course, but a modification of the Curling bandage which consisted essentially of a kerchief folded into a triangle and swung from a belt. But let no one imagine that a band of adhesive plaster across the thighs is an adequate support for the testicles. It is not. This "bellevue bridge" has not been seen in the urological service of Bellevue in twenty-five years.

The patient may get out of bed twenty-four hours after the temperature has become normal if the attack has been a brief one, forty-eight hours after if it has been prolonged. The above-described bandage should then be discarded in favor of a jock-strap.

Then the patient discards his jock-strap for an ordinary suspensory which he wears for three or four weeks.

Local Applications.—Poultices are light and soothing; there seems to be no particular virtue in the once-lauded tobacco poultice. Tucker's saturated solution of magnesium sulphate applied on several layers of gauze and covered with rubber tissue probably acts as a negative poultice. Guaiacol, one part, in



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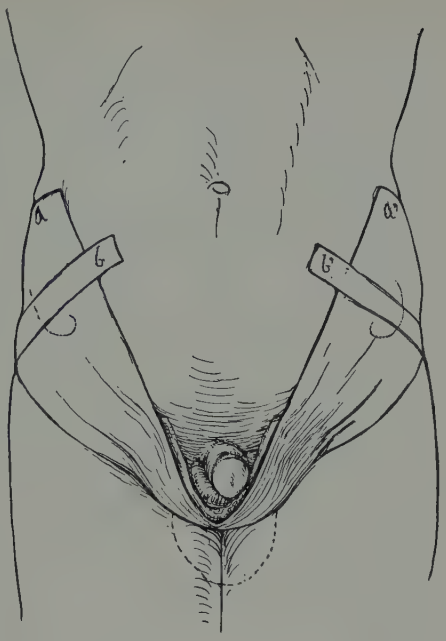

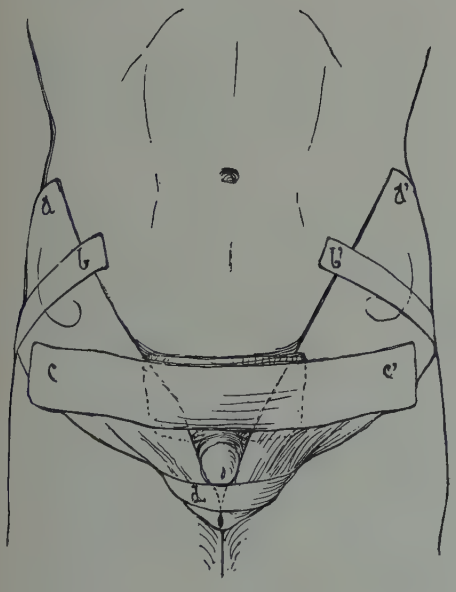

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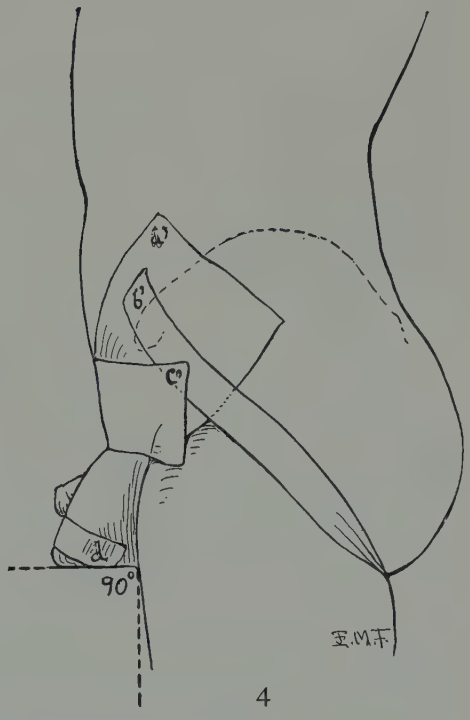

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FIG. 159.—THE EPIDIDYMITIS IMMOBILIZATION BANDAGE.

1, (*a*) The suspensory; (*b*) perineal strap, (*c*) suprapubic strap, (*d*) closure strap. 2, (*a*), (*b*) Crosses at the anterior superior spine. 3, Straps (*c*) (*d*) complete the bandage. 4, A bandage properly applied stands out at right angles to the perpendicular.

glycerin, ten parts, is counterirritant for mild chronic epididymitis. Hot water bags are heavy. To most patients the application of cold, in the form of an ice pack, is more grateful than heat. Diathermy applied for half an hour is lauded by many. I have had no luck with it.

General Treatment.—Apart from a light diet and rest in bed, specific drugs, such as aconite and injections of milk, sodium iodid and vaccines, have fallen into merited disfavor.

Operative Treatment.—Hagner justly claims for his operation the immediate relief of pain, but the convalescence from the operation requires longer than that from the use of the bandage described above, and we reserve operative treatment for those upon whom this immobilization fails.

The claim that operation reduces the prospect of sterility after epididymitis is not supported by any very large statistics and is, perhaps, not well founded.

The Urethra.—Last, but not least, *no vigorous local treatment to the urethra* should be attempted during or after an attack of epididymitis. It will only harm the testicle without helping the canal. Local treatment should be restricted to mild injections and gentle massage. I usually employ no urethral treatment until two weeks after the epididymitis has subsided.

Recurrent Epididymitis.—Each attack of recurrent epididymitis may be treated by the measures detailed above; but between times preventive measures must be instituted to ward off future attacks. This prophylactic treatment may be directed toward the general health, the seminal vesicle, and the testicle itself.

The treatment of the internal genitals depends upon its tolerance. If it will bear instrumentation, instillations, irrigations, and massage help; but in a certain proportion of cases such attempts only serve to stir up the epididymis and make the patient worse. The hot rectal douche is here peculiarly applicable, since it is absolutely harmless.

The testicle itself should always be supported. I have known a man who could not for three months leave off a towel T-bandage which slung his testicles over his abdomen. No lesser support would prevent a recurrence of the attacks. Yet he is now, twenty years later, permanently well and had two children.

If all these palliative measures fail, there is but one alternative. The patient must submit to operation.

Hagner claims for his operation the advantage that the relief of tension reduces the prospect of sterility. In view of the small size of the epididymal canal it is difficult to credit this theory, yet several cases have been reported in support of it. But the immediate relief of pain and fever by operation is enough to commend it for patients that are not relieved by immobilization.

ORCHITIS

Orchitis is either primary or secondary. Secondary orchitis, due to the extension of infection from the epididymis, is unimportant except in those rare

cases when the epididymal infection is so intense as to block the circulation of the testicle by the periepididymal infiltration.

Primary orchitis is of three types: (1) Traumatic orchitis; (2) metastatic orchitis, due to microörganisms, other than the bacteria of suppuration, of which the orchitis of mumps is the only common type; (3) suppurative orchitis.

Attempts, some of them successful, have been made to relieve recurring epididymitis by Belfield's operation of vasotomy and injection of the vesicle or by vasotomy alone for the purpose of occluding the vas. It is wiser to make sure of a cure by removing the epididymis.

On opening the tunica vaginalis and delivering the testicle, the lesions in the epididymis may seem so confined to one portion of that organ as to tempt one to be satisfied with puncture of the suppurating foci or removal of one portion of the epididymis. It is safer to remove it all.

Traumatic Orchitis.—Severe contusion, commonly a kick or a blow inflicted by a missile, causes an acute inflammation of the testis and epididymis, which, though usually short-lived, may terminate in atrophy of the testis, abscess, or gangrene. Yet atrophy may follow a slight injury.

The trauma of epididymectomy may result in orchitis requiring orchidectomy.

Orchitis from strain has been attributed to spasm of the cremaster and to compression of the cord by the abdominal muscles. It may more probably be due to slight torsion.

Orchitis of Mumps.—The orchitis of mumps is most frequent at about puberty. It is almost unknown in childhood. It comes on near the end of the first week of mumps, and is usually confined to a single testicle. The testicle may, however, become inflamed before the parotid, and the mumps may even be confined to the testicle. Orchitis occurs in at least 5 per cent of cases of mumps in young adults. Indeed, Laveran recorded 156 cases of orchitis among 432 cases of mumps occurring in soldiers. The epididymis may or may not be involved. The affection runs a quick course of about a week or ten days, very rarely terminates in suppuration, may subside without leaving behind any impairment of the organ, but is often followed by atrophy. This occurred in seventy-three of Laveran's cases. Abscess and gangrene are very rare.

Suppurative Orchitis.—Suppuration in the body of the testicle by metastasis from infection elsewhere in the body is extremely rare. A mild orchitis due to typhoid fever has been described. Also cases following infection of the upper air passages. But the site of the parent infection is usually about the prostate and bladder. I have seen several such as a complication of prostatectomy. One of these had a low-grade infection characterized by slight persistent fever and grave toxemia. The patient became and remained delirious; I removed both testicles under local anesthesia, but though this relieved the fever, the delirium continued for several months until the improvement in general health was followed by gradual return of the mental faculties which are still normal though two years have elapsed since operation.

Symptoms

Local Symptoms.—The testis increases in size, but seldom becomes very large. This is due to the unyielding nature of the albuginea, and to the fact that there is usually no effusion into the tunica vaginalis. The pain is out of proportion to the amount of swelling. This pain has been compared to that of nephritic or hepatic colic. The pain continues severe for several days, and then gradually becomes more bearable, or it may suddenly cease altogether. This last circumstance is gratifying to the patient only, for it means gangrene of the organ.

The shape of the testicle is rarely altered in orchitis; it is smoothly, regularly ovoid. The epididymis is not distinguishable from the rest of the tumor. The scrotal tissues are often red, swollen, edematous, inflamed.

General Symptoms.—The general symptoms are marked, often severe: chills, high fever, vomiting, hiccough, delirium. These symptoms have been compared to those of strangulated hernia. Indeed, there is more or less strangulation of the testicle within its tight, fibrous sheath.

The disease usually terminates by resolution. The testicle may then remain normal or it may go on to atrophy, this process requiring a number of weeks, at the end of which time nothing is left of the testicle but a small, insensitive mass.

Progress

The progress of the case depends upon its cause. Traumatic orchitis, if uninfected, subsides and ultimately the testicle undergoes more or less atrophy. If infected, the suppuration calls for orchidectomy.

The orchitis of mumps subsides without suppuration but usually results in atrophy and, if bilateral, in sterility.

The suppurating metastatic orchitis, as I have seen it, always requires orchidectomy to cut short the grave infection.

The most acute case of orchitis secondary to acute epididymitis that I have seen was the following: The patient first had an acute colon pyelonephritis on the right side. This subsided and about two weeks later the right epididymis became very acutely infected. Operation revealed an apparently normal testicle and a deep red swollen epididymis spotted with miliary abscesses from head to tail. Epididymectomy was done but the infection continued and four days later the testicle was removed and found riddled with abscesses from which colon bacilli were obtained.

Treatment

It is stated that the orchitis of mumps does not occur if the patient is kept in bed for the first eight days of the disease. This precaution should therefore

be taken with all youths suffering from mumps who are over eleven years of age.

Once the mumps have reached the testicle, the treatment is by immobilization and the ice-cap just as though the lesion were an epididymitis. Even if the pain is acute, it is not likely to last more than three or four days. But very acute pain is a symptom of such tension as to threaten gangrene. It is advised that under these circumstances tension should be relieved by from three to six short cuts in the tunica albuginea. I have never performed this operation. It would seem wiser to do it under direct observation after delivering the testicle rather than subcutaneously.

Suppurative orchitis requires orchidectomy.

Fistula from the testicle will not heal until the substance of the organ has been entirely destroyed and perhaps not then. Orchidectomy should be performed.

In order to prevent orchitis the adolescent with mumps should be kept in bed for at least a week. If orchitis occurs the testicle should be immobilized and an ice-bag applied. This usually suffices to relieve the symptoms but not to prevent atrophy. Intense pain may be relieved by multiple small incisions in the tunica albuginea. These should be made after exposure of the organ by a scrotal incision.

Traumatic orchitis, if severe, and suppurative orchitis, always, require orchidectomy.

CHAPTER LIX

TUBERCULOSIS OF THE EPIDIDYMIS

Tuberculosis affects the testicle in two ways:

1. Diffuse miliary tuberculosis, associated with general miliary tuberculosis, and of no interest to the surgeon.

2. Circumscribed tuberculosis, which concerns us here. This form of tubercle appears as localized deposits, one or more, beginning in the epididymis, and involving the testicle only secondarily.

ETIOLOGY

Pathogenesis.—There are three theories concerning the genesis of genital tuberculosis:

1. That it begins in the prostate or the seminal vesicles whence the epididymis is invaded secondarily, the inflammation extending along the vas or, possibly, by way of the lymphatics.

2. That genital tuberculosis is primary in the epididymis, secondary in the prostate and seminal vesicles.

3. That the tuberculosis, whether occurring primarily in the one end of the seminal canals or in the other, may be due to inoculation during coitus.

Two questions, therefore, arise: Can the inoculation take place during coitus? Is the epididymis invaded primarily or secondarily?

As to infection during coitus, no one holds that such infection is at all frequent. The question is whether or not it ever occurs. Tubercle bacilli have been found in the healthy epididymis (Jani and Weigert), and Paladino-Blandini and Thompson-Walker have apparently shown that bacteria, tubercle bacilli among others, when deposited on the mucous membrane of the urethra near the meatus may reach the epididymis, but cause no inflammation there under ordinary conditions. Yet these experiments prove only that infection in coitus is barely possible, for the combination of circumstances postulated—viz., a massive urethral inoculation and a trauma to the testicle—would be, clinically, hard to find. Inoculation *per urethram* is, to say the least, improbable.

Is the epididymis invaded primarily or secondarily? The highest authorities are divided on this point, and perhaps this division is founded on a diversity of cases, some primary, some secondary. There is no question here of the primary focus in the body, but only of the primary focus in the genital tract. Is it in

the epididymis, or is it in the prostate and vesicle? I cannot answer the question except by an array of facts, all of which seem to point toward the same conclusion: (1) I have examined the urine of every case of tuberculous epididymis that I have seen in the last ten years, and in no case have I failed to find pus in the urine, indicative of prostatitis. (2) I have seen tuberculous prostatitis and vesiculitis without any lesion of the epididymis. (3) When one epididymis becomes implicated, the other being already involved, I am confident that tuberculous internal genitals form the bridge from one side to the other, and therefore the second epididymis, at least, is not involved primarily. (4) At the time of the onset of the first epididymitis, the semen will usually be found to be sterile.

To sum up: With a tuberculous epididymis the prostate is never normal and is sometimes manifestly tuberculous to rectal touch. On the other hand, with a tuberculous prostate or vesicle the epididymis is not necessarily involved. Involvement of the prostate precedes involvement of the second testicle. The migration of the bacteria in sufficient numbers to cause damage is rendered intelligible by Paladino-Blandini's experiments, referred to above, which, while they do not reproduce the conditions requisite for infection in coitus, do represent with sufficient accuracy the conditions of so-called ascending inflammation. All the weight of this evidence goes to show that, in many, if not in all, cases, the prostate or vesicle is tuberculous before the epididymis becomes so. Thompson-Walker believes that the urine from a tuberculous kidney usually is the source of the primary prostatic focus.

The supporters of the theory of primary epididymal tuberculosis insist upon the fact that biologically the epididymis is an excretory organ infected like the kidney from the blood stream.

The *age* at which tuberculous inflammation is most common is between twenty and thirty. Fully half the cases occur between these years, and the disease is very rare before fifteen and after fifty. But a number of cases have been reported in infancy.

PATHOLOGY

Authorities differ as to whether the epithelium or the intertubular tissues of the *epididymis* are first involved, and on these differences build a support to their views upon the primary and secondary nature of the disease. The first lesion is almost invariably found in the globus minor of the epididymis. There it may remain localized, or it may spread by continuity throughout the epididymis and the testicle, or distinct foci may appear in the head of the epididymis. The tubercles conglomerate to form the hard masses so typical of tuberculosis. These go on usually to caseation, suppuration, and fistulization, or else cicatrize or calcify.

The Vas.—The vas is often lumpy with tuberculosis deposits, and may be involved in a perideferentitis. The middle, subperitoneal portion of the vas is

always relatively free from infection. The *vesicle* and *prostate* may be clinically tuberculous.

The Testicle.—The testicle is often invaded by a tuberculoma or by an abscess. Primary tuberculosis of this organ does not occur. Yet testes obtained by castration often show a more or less widely disseminated beginning tuberculosis of this gland. This discovery has been hailed as startling proof of the

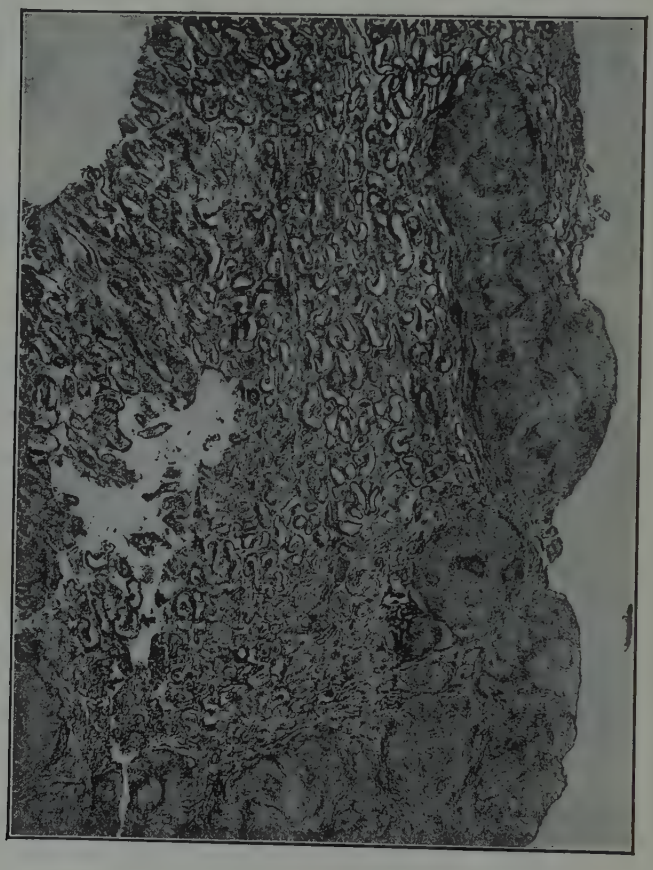

FIG. 160.—SECTION OF TUBERCULOUS TESTICLE.
A group of tubercles invading the healthy tissue.

advantage of total castration; it being very justly urged that the lesions in the testicles would be overlooked by the surgeon intent upon epididymectomy. It is true that these lesions of the testicles are often present in cases treated by conservative operations, as well as in those not treated surgically. But the testicle is able to overcome the infection if given an opportunity by epididymectomy. Thus Barney [1] states that though the testicle is clinically tuberculous

[1] *Bost. M. & S. J.*, 1913, clxviii, No. 25.

in 44 per cent of cases, there has been no local relapse after epididymectomy in "almost 100 cases."

The Vaginalis.—The tunica vaginalis may be studded with tubercles, producing chronic hydrocele. Operation always reveals hydrocele or adhesions within the vaginalis.

The Urinary Organs.—The urinary organs are affected with the genital organs in at least one-third of all cases.

The Lungs.—The lungs are often enough spared. Thus Kocher, among 451 autopsies on cases of urogenital tuberculosis, found as many as 95 (21 per cent) with normal lungs. During life the pulmonary involvement is often insignificant and may antedate the genital infection by many years.

SYMPTOMS

The patient, a young man,[2] comes complaining that one testicle is larger than the other. The swelling may have been spontaneous or it may have followed injury, or perhaps a previous gonorrheal epididymitis never got entirely well and began to swell again. Questioning may disclose a family or a personal history of tuberculosis, or an account of frequent and painful urination perhaps slight, previous, or still existing. The epididymal lesion is almost always tender, rarely painful.

Less often the onset is acute. The testicle is greatly swollen. There is considerable pain, and the vaginalis rapidly fills. This condition may subside, leaving a few nodules here and there, or it may go on to suppuration.

Upon examining such a testicle it is usually found somewhat enlarged throughout, with large, hard nodules at one end or the other of the epididymis, or throughout its length. There may be lumps in the testicle itself. The outline may be obscured by fluid in the tunica vaginalis. The vas deferens may be knotty, enlarged, and hard, as far as it can be felt, and a finger in the rectum may detect the seminal vesicle similarly affected. Nodules may perhaps also be detected in the prostate; the urine contains shreds or free pus, and there are, perhaps, symptoms referable to tuberculosis of prostate, bladder, or kidney. The lungs, too, may be involved. Sexual power and desire are influenced only by the general condition and fears of the patient.

COURSE

The malady usually advances slowly, sometimes remaining stationary for many months. Finally, the nodules soften, the skin adheres, bursts and discharges a thick, cheesy pus. The fistula persists indefinitely.

We occasionally meet with a case which starts like an ordinary acute

[2] Goodman (*Med. Rec.*, 1914, lxxxv, 146) has collected ninety-one cases of tuberculosis of the testicle in children, half of them appearing in children less than two years old. The lesion usually suppurates and involves both the testicle and the epididymis. It therefore requires orchidectomy.

epididymitis, the *tuberculose galopante du testicule* of Duplay, and never remits its fury. In other cases the chronic course of the disease is interrupted by acute exacerbations.

The cases [3] may be divided into two classes: (1) those in which the epididymal lesion is the chief active tuberculous lesion in the body (twenty-six cases), and (2) those in which the tuberculous lesion is only a part—perhaps a relatively unimportant part—of genito-urinary cases (twenty-four in number), or general tuberculosis (thirty-one cases); but no patient remains hard and fast in any class. The clinical picture varies as one or another lesion rises into prominence. One may follow clinically, however, and with some degree of order, the course of the lesion in the epididymis itself, where it may be acute or chronic, suppurating or quiescent, and in its fellow.

The acute onset, as well as the acute exacerbations during the course of the disease, are probably due to mixed infection. Caseation and fistula, however, may occur without any mixed infection.

Such breaking down, whether acute or chronic, simple or tuberculous, occurred in at least seventy-six of the 152 testicles, and probably in more. It is a striking fact, however, that of these seventy-six cases of softening or suppuration, fifty-three occurred in the first year, while late suppuration was noted only once in the third, fourth and fifth years respectively.

It would seem, therefore, that if the process remains chonic in the epididymis for a year or two, it is not very likely to break down.

On the other hand, no suppuration occurred in twenty-nine cases watched for more than one year. Fourteen of these were followed less than four years, nine from four to nine years, and six respectively ten, eleven (two cases), twelve (two cases), and sixteen years.

Azoöspermia.—I have observed that a large proportion of these patients are sterile from the time the *first* testicle is involved. Barney states that 85 per cent of his patients were sterile. On the other hand, Fürbringer [4] alleges that tuberculosis of the epididymis is less likely to entail sterility than is gonorrhea.

Condition of the Opposite Testicle.—Here is perhaps the most important point of all. Many patients permit one testicle to be removed in the hope that the disease is confined to this one organ, and may be amputated. This hope is utterly vain, and relapse upon the opposite side frequently occurs, be the operation ever so slight or ever so radical.

This is proven by the summary of my eighty-seven cases in which it is definitely recorded that the opposite epididymis was or was not affected. Fifty-three so relapsed; thirty-four had not done so when last seen.

Involvement of the opposite epididymis occurred within the first two years in forty-six cases. In only three did this occur after the third year, though ten others remained unilateral for longer periods.

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[3] This and some of the following paragraphs are quoted from my report of a hundred cases of tuberculous epididymitis in *Ann. Surg.*, June, 1907.

[4] *Deutsche med. Wchnschr.*, 1913, xxxix, 1393.

I have followed sixty-nine cases for more than a year. Of the suppurating cases, eighteen were still active when last seen. Sixteen either burst or were incised, suppurating for a certain number of months thereafter, and then were seemingly cured. Seven such apparent cures were followed from three to ten years; one, a bilateral, for twelve; one for thirteen; one, a bilateral, for twenty-five; one for twenty-seven years. Yet, to prove that, no matter how long these patients remain well they are not absolutely guaranteed against relapse: in one case suppuration followed gonorrhea fourteen years after the apparent healing.

Thus 15 per cent of spontaneous cures, watched for more than three years followed suppuration. Yet, on the other hand, those cases which did not suppurate were forever smoldering or advancing. Single cases showed irregular activity as late as five, six, eight, and ten years after the onset; while apparent spontaneous cures were observed at five, eight, nine, twelve, and sixteen years.

Mortality.—I can record no mortality from tuberculosis epididymis. One patient died of phthisis, two of tuberculous meningitis, and two of pelvic abscess after operation; but none of these deaths is directly attributable to the testicle.

Barney reports that 41 per cent of fifty-eight patients died within six years; half of them within a year of operation. Miliary, renal and lung tuberculosis were the usual fatal agencies. The prognosis is simultaneous pulmonary and genital tuberculosis is much graver than that of either alone.

DIAGNOSIS

The three conditions with which the tuberculous testicle is likely to be confused are simple epididymitis, syphilis, and neoplasm. The means for distinguishing the three are the following:

1. Aspiration of hydrocele or drainage of abscess in order that the lesions of testicle and epididymis may be accurately palpated.
2. Familiarity with the clinical aspect of tuberculosis of the testicle—the little round nodules; the diffuse infiltration of the epididymis; the acute epididymo-orchitis; the frequency of hydrocele and abscess; the ever-present sensitiveness to pressure.
3. Tuberculous family history and personal history.
4. Evidence of tuberculosis in the internal genital organs, such as active lesions or chronic tuberculous nodules.
5. The discovery of the tubercle bacillus in the urine, in the pus massaged from prostate, or in the contents of hydrocele fluid or abscess.

Early cases are especially obscure. If the lesion is in the epididymis and sensitive, it is not syphilis; it may be tuberculosis or simple epididymitis. In the absence of prostatic tuberculosis the diagnosis must be reserved for three months. If the lesion is not tuberculous it will quite promptly suppurate or resolve.

TREATMENT

During the three months of waiting so often required to prove the diagnosis, light treatment may help and repeated urinalysis after mild prostatic massage may enlighten the physician.

With a diagnosis, perhaps thus completed, there is no excuse not to operate at once, except active pulmonary lesions. Operable bone or renal tuberculosis should form an excuse to remove the epididymis simultaneously.

The excuse for attacking the epididymis is not that the patient cannot improve without operation. On the contrary many do. But having watched and followed a practice predominantly non-operative for a decade and published the results in 1907, I have since then preferred operation as subjecting the patient to less danger than abstention. Yet to-morrow should bring forth some combination of climate and sanitarium care that should promise much more than surgery. Until then we proceed as follows:

If the epididymal tuberculosis is acute, immobilization, decubitus, local cold and light treatment constitute our therapy. After the acute edema has subsided, the probationary trimester elapsed, and the lesion become relatively insensitive, it should be removed. The operation includes three steps, viz., (1) epididymectomy of the healthy side and (2) then on the sound side evacuation of the tunica vaginalis and (3) epididymectomy with division of the vas at the internal ring after injection into its proximal segment of a few drops of 1 per cent phenol.

Drainage should be introduced. No complications are to be expected after operation unless the surgeon has attempted more than he could perform and has left a testicle with inadequate blood supply. It is the surgeon's responsibility not to do this.

But if the acute mixed infection does not subside, if the case has been long neglected, if the epididymis is adherent to the skin or fistulous and the organ so shrouded in subcutaneous edema that even its exact position is uncertain, well may the surgeon then hesitate to attempt epididymectomy. The patient bitterly opposes orchidectomy, especially if the occasion for neglect is his own reluctance to return for more surgery after he has already sacrificed one testicle with the guarantee that the disease would not recur.

The curettage of the mass, as described in Chapter LIV, will doubtless some day lose a life by acute miliary tuberculosis. Yet it has given me in four cases an uncomplicated convalescence and, on condition that a secondary excision of the one or more nodules and fistulæ that persist, be performed a year or so after the first operation, perfect results may be expected, *i.e.*, a genital function unimpeded by a sense of inferiority and a testicle about which the scars are no thicker than they would be after a gonorrheal epididymitis.

CHAPTER LX

DISEASES OF THE TESTICLE

LUXATION OF THE TESTICLE

P. Bruns[1] records the case of a man run over while lying on his back. The right testicle was dislocated over the pubis at the root of the penis. It remained there and did not atrophy. He refers to other traumatic dislocations, one under the skin of the thigh and a number into the inguinal canal.

HYPERTROPHY AND ATROPHY

Arrest of development is typical in the retained testis and may also affect the normally situated organ for no assignable cause.

True *atrophy* is caused by orchitis, by pressure, as in hydrocele, elephantiasis, by section or obstruction of the spermatic artery, by torsion, by trauma, by severe varicocele, and by injuries to the nerves, spinal cord, and brain. Sexual excess is alleged to have caused atrophy of the testicles. The physiological atrophy of old age has been studied by Desnos,[2] Griffith,[3] and Pawloff.[4]

There are two forms of atrophy, the one *sclerotic,* the result of inflammation, the other *fatty,* the result of an obstruction to the circulation.

The orchitis of mumps is the most frequent cause of atrophy of the testicle.

For atrophy of the testicle there is no treatment.

CONTUSIONS OF THE TESTICLE

Severe contusion of the testicle is rare, notwithstanding the exposed position. There is ecchymosis, and perhaps hematocele or orchitis; atrophy may result. One of the modes formerly adopted in the East for emasculating the attendants of the harem was that of squeezing the testes. The inflammation after injury may be sufficiently severe to result in abscess or gangrene.

Kocher records two deaths from the shock of contusion of the testicles.

Treatment.—If the contusion be severe, the patient must be placed at once upon his back, with the testicle elevated and covered with an ice-cap; if subsequent inflammation occur, orchidectomy will be required.

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[1] *Mitth. aus der chir. Klin. zu Tübingen,* 1884, iii, 483.
[2] *Guyon's Ann.,* 1886, iv, 72.
[3] *J. Anat. & Physiol.,* 1893-94, xxviii, 209.
[4] *Guyon's Ann.,* 1894, xii, 291.

WOUNDS OF THE TESTICLE

Punctured wounds, if small, are of no importance. Penetrating wounds of fair size, however, permit some of the tubular structure of the testis to escape. This is likely to be mistaken for a slough, and to be pulled out as such. Malgaigne mentions a case where the whole pulp of the organ was pulled out in this way. Injuries to the testicle, whether contusions or wounds, are exquisitely painful, and give rise to faintness, nausea, vomiting, and even convulsions. The testis may atrophy as the result of the injury or of a subsequent orchitis.

Treatment.—Hernia of the secreting substance should be reduced if possible, and retained by a suture through the tunica albuginea. If it cannot be reduced, it may be snipped off with the scissors, but should in no case be pulled upon. After the wound has become infected healing will not occur until the whole secreting substance has sloughed away. It is therefore profitable not to delay orchidectomy.

IRRITABLE AND NEURALGIC TESTICLE

Neuralgia of the testis, like that of the ovary, has been attributed to every possible reflex; but certainly its most potent cause is sexual excess or irregularity, and that unchaste continence which revels in the paraphernalia of indecency, lewd books, plays, tales, and thoughts, while seeking to hide beneath the cloak of physical propriety. Temporarily irritable testis may be produced in a healthy person, at any time, by prolonged, and ungratified, sexual excitement. Add to these physical causes a neurotic disposition and the picture is complete.

True reflex neuralgia is commonly seen in the course of arenal colic.

Lesions of the nerves and cord, notably tabes, may cause neuralgia.

It is frequently due to vesiculitis and deferentitis.

Course.—The symptoms of the milder sufferers, attributable chiefly to their psychasthenic disposition, are as variable as their temperaments. But the pain in the vas or epididymis that occurs in unemotional middle-aged men may curse them for years, keep them in semi-invalidism and lead them to submit to a series of operations varying from herniotomy to castration.

The tendency to-day is to attribute such neuralgia to vesiculitis, deferentitis or epididymitis of a mild type. Thus Wesson [5] reports forty-seven industrial insurance cases referred to him for opinion as to the advisability of operation for hernia. He found preformed hernial sacs and tender vasa, also prostatovesiculitis.

Treatment.—The treatment must be founded upon a careful investigation of the actual condition present. The condition of the external inguinal ring and of the seminal vesicles must be studied, as well as the psyche. How difficult

[5] *Calif. & West. Med.*, 1926, xxiv, 212.

it is to be sure of one's conclusions is suggested by perusal of Wesson's publication. His cases might, some of them, be hernias after all.

Elimination of sexual strain will cure many patients. Psychic treatment will persuade others to bear their ills. A suspensory bandage should be worn only if it helps. Sometimes the tighter suspension of a towel tied to a belt relieves pain that is not helped by lesser suspension. Those cases that are helped but not relieved by suspension may sometimes be cured by Vincent's operation for varicocele.

Local counterirritation may soothe mild cases. Ten per cent guaiacol in glycerin may be applied at night.

Massage of the vesicles, the rectal douche, hot or cold diathermy, are all aids. Belfield's operation is said to benefit some. Castration is not guaranteed to relieve the pain.

SYPHILIS OF THE TESTICLE

Syphilis of the testicle is a relatively common and characteristic lesion, which is much more often found on autopsy than during life.

I have record of sixty-seven cases, ten of them bilateral. The following table shows the dates of onset after chancre:

	Cases
4 to 7 months	3
12 to 18 months	5
2 years	4[6]
3 years	9[7]
4 years	6
5 years	1
6 years	4
7 years	3
8 years	1
9 years	2
10 years	1
11 years	4
12 years	3
15 years	2[6]
26 years	1
31 years	1[6]
Indefinite	17[8]
TOTAL	67

[6] One bilateral.
[7] Three bilateral.
[8] Six bilateral.

It will be noted that, though three of the cases occurred between the fourth and the seventh months, the lesion is not common during the first year; though over half of the cases occurred within the first four years.

Yet the appearance of syphilis in both testicles is no evidence of a recent syphilis, as shown by its occurrence once in the fifteenth and once in the thirty-first year.

Morbid Anatomy.—The French school, following Dron, recognize a secondary epididymitis and a tertiary orchitis or epididymo-orchitis. The distinction cannot be clinically established. Of my three earliest cases one was distinctly an orchitis.

The Testicle.—The syphilitic testicle usually shows marked interstitial sclerosis, sometimes considerable gummatous infiltration. Thus the process is the familiar sclerogummatous one. It progresses slowly and painlessly, often with little gross change in the organ.

Active gummatous orchitis, however, may terminate by involvement of the overlying tissues and eruption through the skin, leaving a gummy ulcer.

The Epididymis.—The epididymis alone may be involved (I have seen this but twice), though more often the testicle is implicated as well. The lesion is usually confined to the globus major, which forms a hard, solid, infiltrated mass with a sharp edge. It caps the end of the testicle, separated from it by a distinct sulcus, so that the organ seems to be resting in a clam shell. Gummatous nodules are very rarely felt in the epididymis. This diffuse infiltration, sharp-edged, not nodular and not sensitive, is very characteristic of syphilis. The French speak of it as a "helmet crest."

I have in one instance seen syphilis begin in the epididymis as a rounded nodule, the size of a marrow-fat pea, and to progress by the addition of other nodules in the epididymis and in the testicle itself. These gummata so closely resembled tubercles that the testicle was removed under a mistaken diagnosis. Such rounded nodules in the epididymis, however, are extremely rare.

The Tunica Vaginalis.—Hydrocele is almost always present, but the amount of fluid is, as a rule, not very great. Adhesive vaginalitis is found after the fluid has been resorbed in the course of a cure.

Symptoms.—The characteristics of the syphilitic testicle are *painless and slow growth.* As a rule but one testicle is palpably involved. It does not attain a very great size; it does not ulcerate through the skin unless neglected for a long time.

Examination reveals a testicle wooden in hardness. If the epididymis is involved, the sharp, clam-shell edge of the globus major, less often the globus minor, can usually be made out even without drawing off the hydrocele fluid.

If there is orchitis, the testicle is either generally involved, evenly and densely hard, or else it is of uneven hardness, with projecting small gummata.

The vas deferens was involved in only one of my cases. The general health is not impaired, but, if both testicles are involved, sexual appetite and power are likely to be lost.

Not only is the testicle painless; it usually actually loses its testicular sensation. Indeed, *the opposite apparently healthy organ is often equally insensitive,* thereby evincing unsuspected implication in the disease.

Prognosis.—The prognosis is excellent. Whatever part of the parenchyma has not been destroyed by sclerosis will continue to function, and the testicle which has been syphilitic for years may still secrete spermatozoa. But the patient should be warned that the result of treatment upon an enlarged testicle may be to cause such absorption of the syphilitic tissue as to reduce the gland far below its normal size, while any delay in instituting treatment will only make this atrophy more marked.

The hydrocele disappears with cure of the orchitis.

Diagnosis.—The diagnosis of syphilitic testicle is often easy from the appearance of the organ and the syphilitic history. Exceptionally, the onset of the disease is accompanied by mixed infection, so that for a time the testicle is tender.

This mixed infection is not obviously connected with gonorrhea, and usually leads to the diagnosis of tuberculosis.

The irregular involvement may lead to a diagnosis of neoplasm; but here the general rule applies absolutely: No testicle should be removed for neoplasm until a negative Wassermann reaction has been had. Syphilitic orchitis, like other visceral manifestations of the disease, is marked by the positive Wassermann test.

Treatment.—The antisyphilitic treatment is along the usual lines. We may not expect to bring a badly disorganized testicle back to an entirely normal condition. Local treatment is of no value. The hydrocele requires no treatment.

TUMORS OF THE TESTICLE

Tumors are believed to occur much more commonly in the testicle retained within the abdomen than in the organ normally located. Dean suggests that the abdominal testicle is two hundred times as liable to tumor as is the normal testicle.

If we accept the teratoid origin of tumors of the testicle, we can understand that the frequency of malformations in the abdominal testicle render it peculiarly liable to this type of growth.

It is not proven, however, that the commoner forms of retention of the testicle below the inguinal canal are as liable to tumor as the abdominal testicle.

The conclusions of Ewing's [9] classical study of neoplasms of the testicle, wherein he classifies almost all these confusing and varied neoplasms as teratomata form the foundation of our knowledge of this condition. We quote him as follows:

"In the testis one encounters a wide variety of neoplasms, from the most undifferentiated, diffusely growing, highly malignant, round cell tumors, up to

[9] *Surg., Gynec. & Obst.,* March, 1911, p. 230.

fully adult and harmless tissues and organs, all of which appear to have one and the same origin, the slow or rapid unfolding of original potencies of sex cells. These facts seem to the writer wholly irreconcilable with any relation to an external parasite, but reveal in a striking manner that most important of all facts known about the origin of neoplasms, that embryonal cells possess more than any others the essential factors in the inception of tumors. . . .

"Pure fibroma arising from the stroma of the testicle has probably been observed, but is extremely rare.

"Pure leiomyoma arising from smooth muscle structures of the epididymis or corpus Highmori has probably been observed in a case of Trelat's, but does not appear in recent literature.

"Chondroma, myxoma, lipoma, rhabdomyoma, and carcinoma have not been shown to exist apart from a teratomatous origin. Primary lymphosarcoma arises in the testicle, but its exact cells of origin are as yet undetermined. It may first appear in the rete testis as do teratomata. Pure spindle cell sarcoma probably arises in the testicle, but is rare and its exact origin is uncertain.

"Alveolar, large round cell, perivascular, and other forms of so-called sarcoma testis are of epithelial and teratomatous origin. Adenoma arising from the spermatic tubule cells is a rare tumor occurring in atrophic undescended testes.

"Considerable hyperplasm but no true tumors of the interstitial cells have been observed.

"The commonest tumor of the testis is an embryonal carcinoma alveolar or diffuse with polyhedral or rounded cells and often with lymphoid stroma. These tumors are probably one-sided developments of teratomata. . . .

"That adrenal tissue may appear in true teratomata is shown by one of Ohkubo's cases and in the writer's case 16, a teratoma testis in its second recurrence was indistinguishable from many adrenal tumors. Further evidence would therefore seem necessary to establish the occurrence of a true testicular tumor arising from pure adrenal tissue. . . .

"Standing out prominently from the maze of speculation in this difficult field are two main facts of observation.

"Teratoma testis arises almost invariably where the spermatic tubules enter the rete testis and where some sex cells must fail to realize their full development into spermatogonia. Here is one of those transitional areas where tumors are prone to develop from superfluous and isolated cells.

"Teratoma testis arises at all ages,[10] often after trauma, in testicles that appear to have been normal. The reasonable deduction is that all normal testicles contain the potential cells of origin of teratomata and that such rare accidents as isolation of blastomeres and fertilization of polar bodies are not concerned in their origin. It must be urged that no one has ever seen anything in the testicle which would directly connect teratomata with isolated blastomeres or polar bodies. The existence of such things in the testicle is purely hypothetical.

"*Influenced by these considerations the writer concludes from this study that*

[10] The majority, however, between the ages of fifteen and thirty.

teratoma testis arises from sex cells in the neighborhood of the rete, whose normal development into spermatogonia has been suppressed but whose potencies remain intact and ready to express themselves in the various forms of simple or complex teratomata."

The gross characteristics of the growth may be those of a dermoid cyst, or of a tumor of mixed tissue, solid or cystic, or of a rapidly growing malignant growth.

Secondary hydrocele is a relatively unimportant feature.

FIG. 161.—CARCINOMA OF TESTICLE.

The organ is completely destroyed by the growth. There is hydrocele. (Stewart)

Metastases in the lumbar nodes, the lumbar spine and the liver occur early by way of the lymphatics.

Direct extension occurs through the skin and up the spermatic cord.

Symptoms

The first symptom is a painless tumor, either an irregular nodular mass in the rete, which grows relatively slowly, or a general swelling of the whole testis, due to embryonal cell proliferation, intensely malignant.

The nodular tumor may remain quiescent for several years. One is reported to have begun to grow rapidly after five years' quiescence. The soft tumors spread like wildfire and prove fatal, if untreated. within eighteen months of their first appearance.

Metastasis occurs first by lymphatic extension along the spermatic veins to the lumbar nodes. These enlarge to form large tumors under the outer edge of the rectus at or above the level of the umbilicus. The lymphatic chain follows the thoracic duct to the supraclavicular node on the left side, just external to the attachment of the sternomastoid.

Invasion of the spermatic veins produces a thickening of the cord very characteristic of tumor, since it does not originate in the vas. Vascular metastases are commonest in the lungs and liver.

The disease ultimately invades and breaks through the scrotal skin and then involves the inguinal nodes.

Diagnosis

The examination of patients with tumors of the testicle must include a physical examination of the abdomen, groins and neck, in search of enlarged nodes and the x-ray examination of the trunk for metastases in lung, liver and spine.

The tumor begins in the rete testis, in the region of the junction of the upper part of the epididymis with the back of the testicle.

As seen by the clinician, it develops in one of five different types which, in my practice, have occurred in the following order of frequency:

1. Syphilitic type
2. Hematocele type
3. Hydrocele type
4. Tuberculous type, producing epididymitis
5. Cryptorchid type

1. **Syphilitic Type.**—The testicle and epididymis are more or less distorted by tumor masses which produce an enlargement of varying density, imitating very closely the physical characteristics of the sclerogummatous lesions of the testicle. Syphilis may be suspected from the history, and so far as my experience goes, the Wassermann reaction is a safe guide for primary diagnosis, to be supported by the effect of antisyphilitic therapy. The one patient whom I have seen with a teratoma of the testicle and a positive Wassermann reaction was operated upon for tumor after a brief delay to prove that a few injections of arsphenamin did not influence the growth.

2. **Hematocele Type.**—The testicle and epididymis are lost in a phlegmonous mass. The history of trauma does not help us. The Wassermann reaction is negative. The tumor does not transilluminate. Such testicles should be treated as tumors, on the basis that it is wiser to waste radiation upon a hematocele before operation than to regret afterward.

3. **Hydrocele Type.**—Until one has plunged a needle into a teratoma of the testicle under the impression that it is a hydrocele, it is perhaps impossible really to appreciate how precisely a rapidly growing cellular tumor can imitate all of

the characteristics of a hydrocele, except that of translucency. Hence the absolute rule that the diagnosis of hydrocele should always be confirmed by transillumination before it is operated upon or even aspirated. Yet the two can be absolutely distinguished by Dean's sign. As the hydrocele grows, it draws the penile skin over itself, causing an apparent shortening of the penis. This the tumor never does.

4. Tuberculous Type.—I have seen three cases so early that the tumor was confined to the region of the rete and had extended into the epididymis in such a way as to suggest tuberculosis, or chronic epididymitis.

Also, the tumor sometimes extends upward within the veins of the pampiniform plexus in the fascia immediately surrounding these, forming a dense cord that may be mistaken for a tuberculous thickening of the vas deferens, though the tumor mass may not involve the vas, which can then be felt as a separate, thin cord behind it. Such cases have been mistaken for tuberculosis.

5. Cryptorchid Type.—The tumor grows in the testicle, either in the groin or in the pelvis. In one case, at Bellevue Hospital, the patient had an acute gonorrhea and a rather rapidly growing swelling in the left groin, and the left testicle was absent from the scrotum. Abscess of the left epididymis was diagnosed. This abscess was incised and pus obtained, but the wound did not heal and a subsequent biopsy disclosed tumor.

An abdominal testicle afflicted with tumor shows itself as a rapidly growing, extensive, inoperable pelvic tumor. I have known such a case to be reported as a sarcoma of the bladder. I do not know that teratoma in an abdominal testicle has been controlled by any form of treatment.

The general practitioner must learn the importance of palpating the testicle with sufficient precision to permit an occasional diagnosis of tumor at its earliest and most curable stage, while we must discourage vehemently the diagnostic aspiration of supposed hydroceles and the removal of supposed syphilitic testicles or hematoceles without consideration of tumor.

Prognosis

Without irradiation prognosis is utterly bad. The teratoma is congenital. Its malignant degeneration does not apparently become active until the second or third decade of life. But once this activity has been established, a survival of two years is rare. Death occurs by general cachexia, hastened by metastases in lung, liver, brain or stomach.

The statistics given below suggest that irradiation bids us hope for a brighter future.

Treatment

The modern methods of attack upon tumors of the testicle have entirely changed the prognosis. Surgery alone gave extremely bad results. Tanner [11]

[11] "Tumors of the Testicle," *Surg., Gynec. & Obst.*, 1922, xxxv, 565-572.

reports six hundred tumors nearly all treated by orchidectomy alone. Of the 465 that were followed only twenty-five were well four years after operation.

The so-called radical operation which follows and extirpates the lymphatic chain up to the kidney has a record which is no better. Thus Hinman [12] who performed this operation indiscriminately upon all cases, reports seventy-nine histories with twenty-nine survivals, only six of them followed four years. Coley [13] reports twenty-two survivals out of seventy-eight cases treated by his toxins in connection with operation.

The combination of radiation and operation does much better. At the Memorial Hospital, Dean reports that treatment for cases without evident metastases is given both to the tumor and to the abdomen. To the tumor is applied a radium pack consisting of a brass box whose sides are 1 mm. in thickness, containing silver tubes of radium emanation with walls ½ mm. in thickness; 9,000 mc. hours are given with this at a distance of 6 cm. Then a high voltage x-ray treatment of 220 ma. minutes with a focal distance of 50 cm. and filters of ½ mm. copper and ½ mm. aluminum. To the abdomen on the same side, the radium pack is given for 20,000 mc. hours at 10 cm. distance and the high voltage x-ray 240 ma. minutes at 50 cm. distance, while posteriorly the x-ray is given for 320 ma. minutes at 50 cm. distance.

Four weeks after this treatment the testicle, if occupied by a soft tumor, will have shrunken practically to a normal size. It is nevertheless to be removed and the abdominal exposures repeated two or three times at intervals of two or three months, even when no signs of tumor are present.

Metastases are never operated upon. The above irradiation treatment is depended upon to control them. Dean divides his 124 cases as follows:

1. Cases not previously treated and without metastases—9 out of 13 known survivals.
2. Untreated cases with metastases—4 out of 16 cases survived.
3. Recurrences without metastases—3 cases all survived for three years.
4. Recurrences with metastases—81 cases with 26 known survivals.
5. Irradiation of cases operated elsewhere—8 out of 11 survived. None of these had palpable metastases.

In short, of the twenty-seven cases seen without palpable metastases, twenty are known to be well at the time of the report; six of these have been followed for three years and four for five years. Of the ninety-seven cases first seen with metastases, thirty are known to be alive and well, and eight of these have been followed three years, five of them for five years. The prognosis of the condition after the appearance of metastases is therefore doubtless about four times as bad as it is before their appearance.

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[12] *Surg., Gynec. & Obst.*, 1923, xxvii, 429.
[13] *Ann. Surg.*, 1923, lxxvii, 370.

CHAPTER LXI

HYDROCELE, HEMATOCELE, SPERMATOCELE, CHYLOCELE

Hydrocele is usually defined as an accumulation of serous fluid in the tunica vaginalis. Hydrocele may also occur in the funicular process of the peritoneum as encysted hydrocele of the cord.

Varieties.—Hydrocele may be idiopathic or symptomatic. It may be acute or chronic. While all idiopathic cases are chronic, not all symptomatic cases are acute, therefore the terms are not quite interchangeable. A *fibrous adhesive vaginalitis* has been often noted postmortem or during operation. It gives no clinical symptoms.

Doubtless there is no such thing as idiopathic hydrocele, and every vaginalitis is symptomatic. One may agree to this as a pathological observation without finding in it any clinical consolation. Every operation upon the so-called idiopathic hydrocele reveals adhesions within the tunica vaginalis that must be the result of infection. Yet the distinction between symptomatic and idiopathic hydrocele holds, for the former is the manifest result of a recognized infection and singularly enough often subsides and leaves no permanent ill results. On the other hand, idiopathic hydrocele not infrequently occurs in patients who have had no known infection of the urinary organs or of the internal genitalia. It is said to be much commoner in the tropics than in temperate climates. In spite of the absence of known cause, it is obstinately chronic.

Hydrocele is most common in the middle-aged. In the tropics it is said to afflict one man in ten. It is far less common in temperate climes.

SYMPTOMATIC HYDROCELE

As its name suggests, symptomatic hydrocele occurs only as a symptom of disease in the testicle and epididymis. It is often acute, and is especially common with acute epididymitis and tuberculosis of the epididymis.

Treatment.—The treatment of symptomatic hydrocele is, in some degree, comparable to the treatment of serous pleurisy. If the primary disease is acute and the hydrocele insignificant, it may be disregarded and allowed to be absorbed as the acute disease abates. If large and tense, or its absorption too slow, it may be aspirated one or several times. But if the primary disease is chronic, while aspiration may hold the hydrocele in check, some more radical procedure is often demanded. The need of this may prove the surgeon's op-

portunity to induce the patient to submit to an operation upon his testicle from which he otherwise would shrink.

IDIOPATHIC HYDROCELE

Varieties.—Hydrocele is usually confined to the tunica vaginalis (Fig. 162). It may occur before the funicular process has begun to close, as *congenital hydrocele,* so that the cavity of the hydrocele communicates with the peritoneal cavity, yet by such a small opening that there is often no hernia and the fluid does not spontaneously drain off into the abdomen (Fig. 163). A more frequent variety is *infantile hydrocele,* occurring when the funicular process has

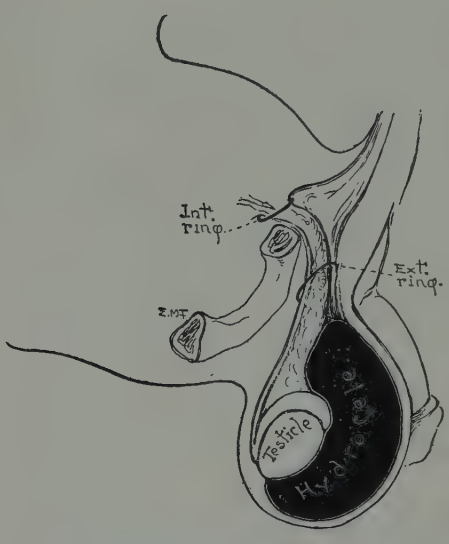

Fig. 162.—Hydrocele of Tunica Vaginalis.

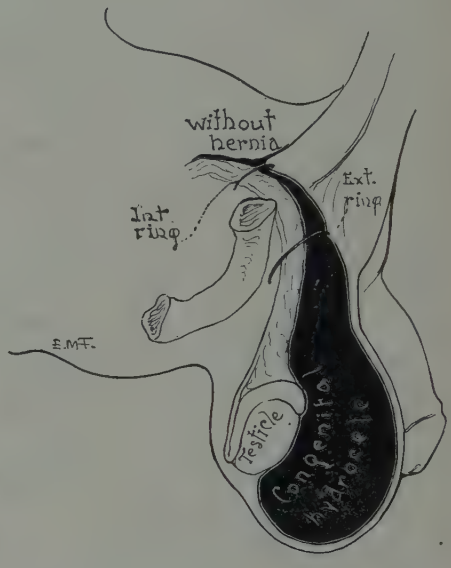

Fig. 163.—Congenital Hydrocele.

quite closed at its upper end, so that the fluid distends both vaginalis and funicular process (Fig. 164). Hydrocele occurring in a retained testis is termed *inguinal hydrocele* (Fig. 165).

Pathology.—*The Character of the Fluid.*—The fluid of hydrocele is viscid, odorless, straw-colored, clear, or opalescent. It looks like blood-serum. Its specific gravity is about 1.024. It contains about 6 per cent of organic matter, notably fibrinogen, to which it owes its property of coagulating blood-serum. The alkaline carbonates and sodium chlorid are present in some quantity. The reaction is neutral. The presence of fibrinogen and inorganic salts distinguishes it from ascitic fluid. It may contain a few flakes and strings resembling urethral shreds. It is sometimes brown from the admixture of blood, the result of previous punctures. Cholesterin crystals are usually present, not often in any numbers.

The Quantity of Fluid.—A good-sized hydrocele contains some 200 or 300 c.c. of fluid. Mr. Cline[1] removed 6 quarts from the scrotum of Gibbon the historian. Breisson, after removing 16 liters on one occasion, drew 26 liters from the same patient ten months later. It takes from three months to a year for a good-sized hydrocele to refill after tapping. The largest hydroceles I ever operated upon held 2,500 c.c. and 1,500 c.c. (right and left sides of the same patient).

The Tunica Vaginalis.—The sac of a hydrocele may remain normal in structure even after the disease has existed for some time. Support to the testicle and systematic tapping may prolong this condition indefinitely. But if the scrotum is not supported, the slight bruising which the tumor continually

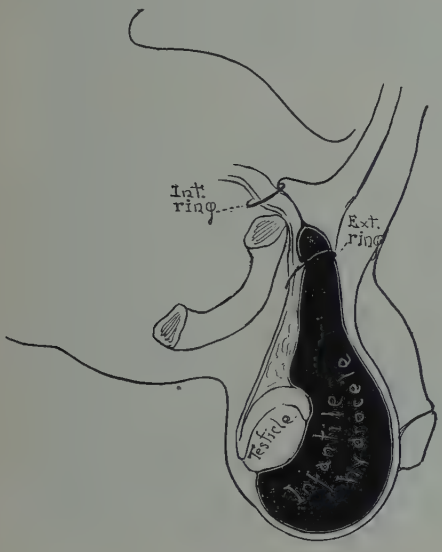

FIG. 164.—INFANTILE HYDROCELE.

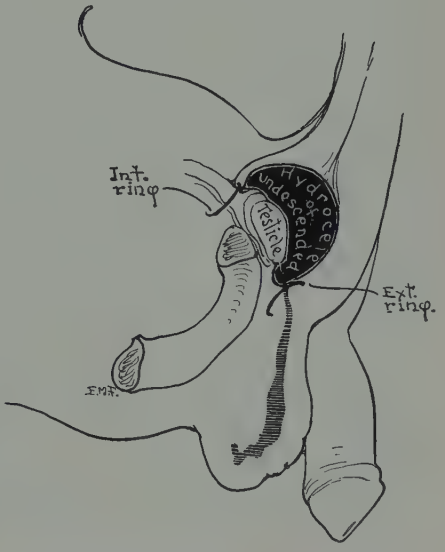

FIG. 165.—INGUINAL HYDROCELE.

suffers may produce a chronic thickening in the tunica vaginalis; the surface loses its gloss and becomes wrinkled and irregular, while the vaginalis becomes thick and leathery. Adhesions and masses of fibrin result from inflammation. Obliteration of some part of the sac may subdivide it, causing *multilocular hydrocele.* I have twice met with *calcification of the vaginalis,* a very rare condition, which has been exhaustively described by Roswell Park.[2]

The Testicle and Epididymis.—Unless inverted or displaced by adhesions, the testicle lies below and behind the hydrocele. In mild cases the testicle remains normal, but after evacuation of the fluid one or more areas of induration may commonly be found in the epididymis. These are points of intertubular edema due to the interference with circulation. In old and in-

[1] *Lancet,* 1885, i, 748.
[2] *J. Cutan. & Genito-Urin. Dis.,* 1895, xiii, 361.

flamed cases of hydrocele, both testis and epididymis may be quite sclerosed and so atrophied as to be scarcely recognizable in the sac wall. The tunica vaginalis may force its way between the testicle and epididymis.

Multilocular Hydrocele.—Multilocular hydrocele is quite rare. It may be produced in one of three ways:

1. Several varieties of hydrocele exist simultaneously, *e. g.*, hydrocele of the vaginalis and hydrocele of the cord.
2. The sac becomes subdivided by adhesions.
3. There is hernia of the sac between testis and epididymis.

Fibrous Bodies.—The so-called fibrous bodies, occasionally met with upon opening a hydrocele, are concretions of earthy phosphates or carbonates covered with fibrin. Probably they are for the most part due to a deposition of the hydrocele salts upon some warty growth, followed by atrophy of the little nucleus, after which the concretion breaks free. They do not exceed the size of a pea and are usually single.

Symptoms.—Idiopathic hydrocele is always chronic. The effusion takes place slowly and painlessly, and the swelling is only discovered after it has attained some size, for which reason the patient fancies it has appeared suddenly. The accumulation of fluid is slow and interrupted, but continues indefinitely. After tapping, the reaccumulation is at first rapid and then slow until the tumor reaches its original size, usually several months after tapping. Thus I have a patient who, refusing any radical measures, returned twice a year for eleven years to be tapped, having, for a number of years previous to that date, visited other surgeons for the same purpose.

There are no subjective symptoms attached to hydrocele, except the sensation of dragging felt in the loin and groin from the weight of the tumor.

Signs.—Hydrocele is usually pear-shaped, larger below than above; or it may be oval, and, if very large, sausage-shaped. It cannot be reduced by pressure. Fluctuation can usually not be made out. The tumor is tense, the scrotum often stretched and shining. As the skin stretches, the penis sinks behind the tumor and tends more and more to disappear (Figs. 166, 167). The cord, of natural size and feel, can be grasped above the tumor. The testicle is usually situated behind, a little below the center, and pressure on this point gives rise to the peculiar sensation experienced when the testicle is squeezed. Occasionally the testicle is found below and in front, more rarely in the center, in front, from plastic adhesion. Its position should always be ascertained before operating on a hydrocele. Pressure on a hydrocele does not produce pain; there is no heat or redness of the skin unless the tumor be large enough to keep it constantly on the stretch. There is flatness on percussion. There is no impulse on coughing, unless the hydrocele is infantile or is complicated by hernia.

The weight of the tumor is a criterion that has been much depended upon to distinguish solid from fluid tumors. This is absolutely unreliable.

Varicocele and hernia may complicate hydrocele, and the pressure on the

testicle may render it sterile. But if the hydrocele is cured the testicle will resume its functions unless it has become atrophied.

Diagnosis.—The diagnosis is made by three tests:

1. The light test
2. Isolation of the tumor
3. Puncture

The Light Test.—Most hydroceles are so thin-walled that if an electric torch is held close to one side of the tumor and the opposite side inspected

FIG. 166.—LARGE BILATERAL HYDROCELE.
Note disappearance of penis.

through a roll of paper or in a dark room, the whole mass glows with a pinkish light. The position of the testicle may be discerned by its shadow.

A certain translucency is observed in some hernias.

This test rules out hematocele, most spermatoceles, and solid tumors of the testicle, but does not exclude a complicating hernia.

If the walls of the hydrocele are thickened, the light test fails.

If the test fails and the tumor has every other aspect of hydrocele, it is doubtless a spermatocele.

Isolation of the Tumor.—If the fingers can be brought together above the tumor and feel nothing but the normal tissues of the cord, hernia is excluded.

If the tumor runs into the inguinal canal and gives no impulse on coughing, there is *probably* no hernia.

Puncture.—The tumor should not be punctured unless hernia can be *absolutely* excluded by isolation, and tumor by the light test. Puncture as a diagnostic test is, in other words, both dangerous and unnecessary.

Prognosis.—Hydrocele in the adult does not disappear spontaneously. Suppuration and transformation into hematocele are rare. Curling cites the case of a Spaniard who had ruptured his hydrocele thirty times by horseback riding and other violent exercises; yet the swelling always returned after a few months. Infants often get well spontaneously, and expectant treatment is therefore most suitable for them.

FIG. 167.—VERY LARGE HYDROCELE. The penis has entirely disappeared. (Raworth Williams)

Treatment.—Aspiration is appropriate to symptomatic hydrocele, for children—for whom it is often curative—and for patients refusing radical measures. Before tapping for hydrocele the testicle must be accurately located by the light test, and hernia and tumor must be *absolutely* excluded. Hydrocele in the adult will refill after this operation. The blood transfusion apparatus makes an excellent aspirator. The patient can put on a suspensory bandage and resume work at once after tapping.

But tapping or aspiration is at best a palliative measure. Cure demands operation. The best way to operate is by the open method, under general anesthesia if the surgeon is inexpert or the patient nervous, under local anesthesia otherwise. The inversion of the tunic described in Chapter LIV is the method of choice because it permits immediate suture and rapid convalescence. It is substantially without complications unless the testicle becomes twisted in replacing it in the scrotum. In that event gangrene ensues.

If care is not taken to invert the pocket that surrounds the cord above the testicle, hydrocele will reform at this point.

The injection of carbolic acid has the disadvantage of requiring much more precision than the open operation and of failing to cure any but the smaller, less inflamed cases. If the sac is thick or the hydrocele contains more than 100 c.c., it is likely to fail. On the other hand, it has the advantage of not hospitalizing the patient or losing more than a day or so of his time.

CONGENITAL HYDROCELE

Congenital hydrocele occurs when there has been no obliteration of the peritoneal prolongation, and the tunica vaginalis is continuous with the peritoneum (Fig. 163). It occurs in infancy.

Diagnosis.—The diagnosis is easy except when congenital hydrocele and hernia coexist (Fig. 168). Then it must be made by exploratory operation.

Congenital hydrocele may be found in adults, but is rare. Horwitz met with it once in 110 cases. Kocher estimates that it occurs four times in every hundred.

Treatment.—Open operation; never injection.

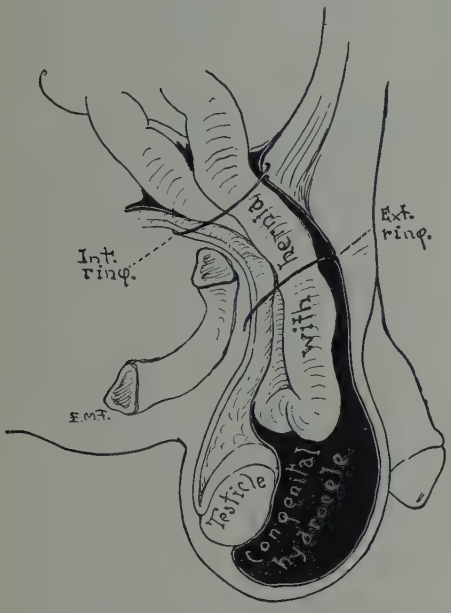

FIG. 168.—HYDROCELE AND HERNIA.

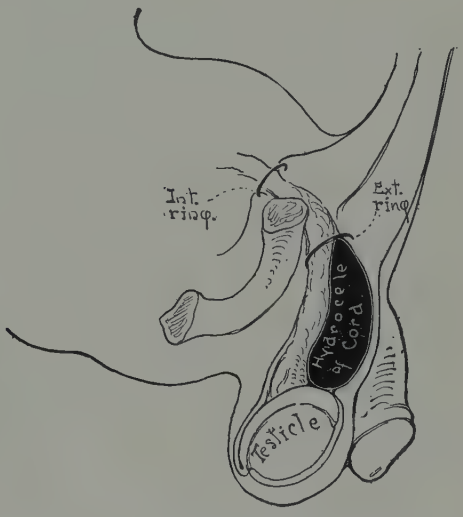

FIG. 169.—HYDROCELE OF SPERMATIC CORD.

INFANTILE HYDROCELE

Infantile hydrocele is perhaps twenty times more common than the congenital variety. The hydrocele occupies the tunica vaginalis and the funicular process up to the inguinal canal, where it is shut off from the general peritoneal cavity (Fig. 169).

Treatment.—Since these hydroceles are usually complicated by hernia, they should never be injected, always subject to open operation.

Abdominal Hydrocele (Bilocular Hydrocele, Hydrocèle en Bissac).—This is the rarest variety of hydrocele, the hydrocele is partly in the scrotum, partly in the abdomen. The abdominal portion, which may grow to an enormous size, usually lies between the general peritoneal cavity and the anterior

abdominal wall. By pressing the abdominal muscles the patient can force the fluid violently into the scrotum.

Treatment.—Excision of the sac. I have operated upon one case in which the tumor reached to the umbilicus. The sac was freed through an abdominal incision. It was then drawn down and excised through an incision over the inguinal canal. The canal was then repaired by the Bassini method.

ENCYSTED HYDROCELE OF THE CORD

Conditions commonly grouped as encysted hydrocele of the cord are:

1. Hydrocele of the processus funicularis
2. Pedunculated cysts of the epididymis, or spermatocele
3. Hydrocele of an old hernial sac

1. Hydrocele of the Processus Funicularis.—The sac is shut off below from the tunica vaginalis, above from the peritoneum. The hydrocele may be single or multiple. Usually single, it presents the features of a hydrocele of the tunica vaginalis, but is situated above the testicle and about the vas. Sometimes it may be reduced into the inguinal canal, but never into the abdomen. Although it usually occurs in children, I have several times seen it in the adult.

2. See Cyst of the Epididymis—Spermatocele.

Hydrocele of an Old Hernial Sac.—This occurs in the process of peritoneum left behind by a hernia which has been reduced and the neck of the sac closed, either spontaneously or by the use of the injection cure for hernia. The hydrocele is usually mistaken for a recurrence of the hernia.

Treatment.—The sac should be incised and its parietal layer removed.

Hematocele.—Hematocele of the cord is rare, but may occur in the same way as hematocele of the tunica vaginalis, usually after injury. Indications for treatment are the same.

MULTILOCULAR HYDROCELE OF THE CORD

Multilocular hydrocele of the cord may be classified under five heads, viz.:

1. Echinococcus cyst
2. Spermatocele
3. Encysted hydrocele of the cord subdivided into loculi by adhesive inflammation
4. Cysts of fetal remains (Müller's duct, wolffian body, organ of Giraldès)
5. Cystic lymphangioma

The symptoms are characteristic, whatever the nature of the disease. The tumor extends about the cord from the testis up or into the spermatic canal. It is smooth, rounded, translucent, and boggy rather than fluctuating, though a difference in this regard may be made out in different parts of the tumor. It may be partly reducible. There is a slight impulse on coughing.

The diagnosis from encysted hydrocele of the cord is established by the boggy feel and the irregular, indistinct outlines of the tumor. In fact, it resembles an incarcerated omental hernia in everything but its translucency and its fluctuation in places. Incision may be required to establish the diagnosis and to remove the mass.

CYST OF THE EPIDIDYMIS—SPERMATOCELE

This condition, commonly known as spermatocele, is a collection of fluid contained in a cyst or cysts springing from the tunica vaginalis. These cysts are developed in and about the epididymis, very exceptionally in the testicle itself, and should be classified as epididymal cysts. Two classes may be recognized:

1. Small cysts developing, usually, about the epididymis (Fig. 170).
2. Large cysts originating within the epididymis (Fig. 171).

1. The *small cysts* are rarely encountered before middle age, while they are very common in later life. They usually project more or less distinctly from the head of the epididymis. They do not attain a diameter of more than 2 cm.; they rarely contain spermatozoa —in short, they have little clinical significance.

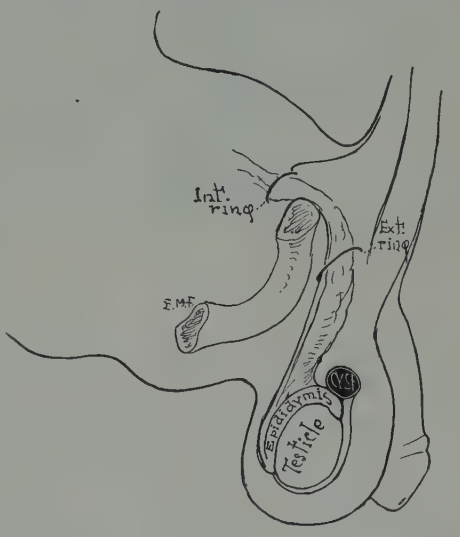

Fig. 170.—Small Spermatocele.

2. The *large cysts* usually appear before middle age and commonly contain spermatozoa. They are often multiple and grow between the epididymis and the testicle, separating them and unraveling the former. Thus they form irregular fluid tumors about the top of the gland. Exceptionally, the cysts are pedunculated and grow upward, simulating hydrocele of the cord.

I have seen cases that precisely simulated hydrocele of the tunica vaginalis in every respect except translucency. The sac lay in front of the testicle with the vaginalis between. In other cases the cyst ruptures into and forms a *spermatocele of the tunica vaginalis.*

These cysts rarely contain more than 100 c.c. of fluid, though Curling drew off 32 ounces from one individual and 40 ounces from another. Jacobson mentions a case from whose right side 49 ounces were drawn, and 58 from the left. The nature of these large cysts is identified when the fluid is milky and swarming with spermatozoa or else absolutely watery, never yellow.

Pathogenesis.—Since the smaller cysts occur later in life than the larger, and less frequently contain spermatozoa, many authors attribute the larger cysts to persistent fetal remains, such as the vasa aberrantia, the hydatid of Morgagni, or the paradidymis (organ of Giraldès), and the smaller cysts to dilatations of the seminal canals. The recent tendency, however, has been to discredit the claims of the fetal elements, and to attribute the earlier and larger cysts to dilatation of the vasa efferentia or of the epididymis itself behind an obstacle more or less impervious, and the later, smaller tumors to a cystic enlargement of the tubules due to senile changes after the organ has passed the height of its sexual activity.

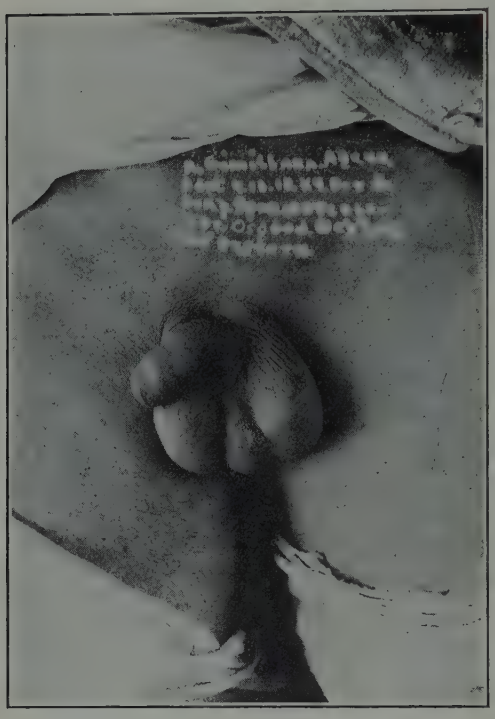

FIG. 171.—LARGE SPERMATOCELE.

The presence of spermatozoa in the cysts as explained by those who cling to the theory of embryonal rests upon the ground that the cyst has burst into the epididymal canal. *The absence of spermatic elements* is explained by those of the opposite camp on the ground that the cysts become occluded from the main channel and their seminal elements gradually disintegrate. The communication between a cyst and a seminal duct has been observed a number of times.

Diagnosis.—The diagnosis is usually made by the position of the tumor above the testicle or the absence of translucency in a supposed hydrocele. Otherwise the diagnosis is not made until an operation for hydrocele reveals the watery or chalk-and-watery character of the fluid. Aspiration usually completes the diagnosis by withdrawing a milky fluid full of spermatozoa. If the fluid is not milky it is distinguished from hydrocele fluid by its watery limpidity, whereas hydrocele fluid is straw-colored.

Treatment.—There is no object in disturbing small cysts. Incision and injection do not cure. The large cysts may be excised.

HEMATOCELE

The term *hematoma* is applied to a tumor caused by the effusion of blood into the tissues, whether of the testis or the scrotum. If the effusion becomes

encysted, or if it occurs within a cyst or the tunica vaginalis, *hematocele* results. I have seen the hemato-spermatocele.

Etiology.—The most common cause is a crushing injury. Any operation upon the testis may result in hematocele.

Symptoms.—There are two varieties. The one comes on rapidly after injury and is attended by scrotal hematocele. If there has been a preëxisting cyst or hydrocele this becomes suddenly larger, more tense, and painful.

In the other, or spontaneous variety, the tumor increases slowly in size and simulates hydrocele, except in regard to translucency.

The blood in hematocele may be found red and fluid, but is usually black or brown, and it may be mixed with pus if severe inflammation has followed its effusion. The walls of the cyst may be coated with layers of fibrin, and they tend to thicken and become adherent to the surrounding connective tissue, while the inner surface becomes rough and uneven, resembling anything but a serous surface.

Diagnosis.—Hematocele without a history of trauma is usually mistaken and removed for tumor. This is the correct treatment. Exceptionally the onset is so acute that spontaneous hematocele may be recognized before operation.

Treatment.—At first all that can be done is to keep the patient upon his back, with the testicle supported and covered with an ice-cap, administering an anodyne if the pain be severe. If the quantity of blood effused is not too great, the pain will soon begin to subside, and the patient may be allowed to go about with a suspensory bandage. The blood will gradually be absorbed.

If, in spite of these means, the pain becomes excessive, and the tension of the parts great, the tumor should be incised and drained.

Ancient hematocele demands castration.

CHYLOCELE

Chylocele (fatty, milky, chylous hydrocele, galactocele) is an accumulation in the tunica vaginalis of chyle or fatty lymph. It is a feature of lymph scrotum, and is caused by the rupture of a dilated lymph vessel into the tunica vaginalis. Filarial embryos have been seen in the fluid by Martin and Davies. Chylocele may also be due to traumatic rupture of the lymphatic into the tunica vaginalis. False chylocele is due to a fat- or cholesterin-producing degeneration in the fluid or in the epithelium of a hydrocele.

Chylocele when occurring without lymph scrotum resembles hematocele. The treatment is excision.

CHAPTER LXII

DISEASES OF THE SPERMATIC CORD

Wounds of the Cord.—Injuries and wounds to the vas deferens and spermatic cord are of interest chiefly in that they usually result in obliteration of the arteries and gangrene of the testicle. If the wound is infected the testicle may as well be sacrificed before it begins to slough. If uninfected, there is a slight chance that suture without drainage may save the testicle.

There is current a scarcely credible belief that the vas, divided by the surgeon, may reunite with patent lumen. I have not seen this happen.

Torsion of the cord, hydrocele and hematocele are discussed in Chapters LX and LXI.

The anomalies of the cord follow those of the testicle.

Deferentitis.—Inflammation of the vas forms the transfer, as it were, of infection from the vesicle to the epididymis. In this transfer there is doubtless always some deferentitis. Yet this usually gives no clinical signs. Deferentitis is recognized clinically under three forms; viz., acute non-tuberculous deferentitis, acute tuberculous deferentitis, chronic deferentitis.

The acute infection, whether tuberculous or not, may be recognized as a perideferential thickening springing from the seminal vesicle and appearing again at the external ring. A slight inflammation of this sort may precede the non-tuberculous inflammation of the epididymis but is far more likely to appear later as a complication. But the more sluggish progress of tuberculosis permits a definite perideferentitis occasionally to appear at the external ring before the epididymis is infected. Prompt operation of epididymectomy may then anticipate the infection there.

Much more commonly the deferentitis extends from an epididymis already inflamed backward up the vas. Muscular trauma at the inguinal canal not infrequently excites suppuration there that requires drainage or, if seen early enough, vasectomy. The intra-abdominal portion of the vas is relatively immune to inflammation.

The neuralgia resulting from chronic deferentitis has been described in Chapter LX.

VARICOCELE

Varicocele is varicosity of the veins of the pampiniform plexus. It may be either symptomatic or spontaneous.

Symptomatic Varicocele.—Symptomatic varicocele is rare. It is caused by the pressure of some intra-abdominal growth obstructing the spermatic veins. The tumor is of retroperitoneal origin and malignant. It is usually renal.

Diagnosis.—Symptomatic varicocele cannot be mistaken for spontaneous varicocele. It develops very rapidly, late in life, on either side; is painless, attains large proportions, and is associated with a palpable abdominal tumor, against which the treatment should be directed.

Spontaneous Varicocele.—Varicocele in a mild form is perhaps the most common affection of the genital organs. It has been estimated that 10 to 20 per cent of males have slight varicocele. It occurs almost invariably on the left side; when very marked on this side it may exist slightly on the right. I have operated only once on the right side.

Most slight varicoceles are encountered in young unmarried men; the affection rarely commences after twenty-five; it is unusual to find it in a married man whose sexual relations are satisfactory. The chief factor in its production is ungratified sexual desire, unrelieved erotic fancies, which is really the opposite condition, abuse of the sexual powers, by which the veins are kept constantly engorged. The slight turgescence of the veins constituting varicocele in a young bachelor and often causing him needless alarm, disappears after marriage, together with the uneasy sensations which accompany it.

Old men whose testicles are inactive rarely have varicocele, though their legs show many tortuous veins. This fact is of the utmost importance. That slight varicocele is often a sexual derangement, a functional disorder depending upon vicious sexual hygiene, is not sufficiently appreciated by practitioners. In many cases young men distress themselves unceasingly, and importune their surgeons for an operation to cure a disorder which would be more speedily and effectually removed by sex hygiene.

The degree of varicocele alluded to above may be dismissed briefly. The vessels are a little full, the cord loose, feeling like a small bundle of earthworms; the testicle is perhaps oversensitive, and there is usually a slight dragging sensation in the groin, but beyond this nothing except the fancied ills and the hypochondriacal complainings of the young man who is cheating Nature or abusing her gifts.

Yet varicocele serious enough to constitute a disease and to demand active surgical measures for its relief does occur. It is an exaggeration of the milder form; it comes on in early manhood, and has no connection with varices of the legs or anus.

Pathogenesis.—Any theory to be adequate must explain the prevalence of the disease among the adolescent and its occurrence, almost entirely, upon the left side.

Many authors look for an anatomical predisposing cause. Thus certain French writers invoke a preëxisting phlebitis. Bennett [1] and Spenser [2] suppose

[1] *On Varicocele,* London, 1891.
[2] *St. Barth. Hosp. Rep.,* 1887, p. 137.

a congenital anomaly of the veins. Such predisposing causes are not generally accepted. Sufficient anatomical predisposition is found in the position of the veins, dependent, unsupported, surrounded by the loosest kind of a fascial envelope. To this add the congestion set up by the untamed and pampered passions of youth, and no further predisposing cause is necessary.

But why should the varicocele occur upon the left side? To answer this question an infinite variety of theories has been proposed. There is space to enumerate only the more important ones. The left testis hangs lower than the right, and the left renal vein is higher than the opening in the cava which receives the right spermatic vein, hence the left vein is longer than the right. To this add the fact that the left spermatic vein enters the renal vein at right angles, and is not affected by suction as is the right vein which enters the cava at an acute angle. So far we are on safe anatomical ground; beyond all is theory. Perhaps, as has been alleged, right-handed men transmit the force of their exertions to the left foot by means of the abdominal muscles of the left side. But I have seen left-handed men with varicocele, always on the left side. Perhaps the sigmoid flexure, overloaded with feces, presses upon the veins. But this is as rare in youth when varicocele is common, as it is common in old age when varicocele does not occur. Curiously enough the ovarian veins are very rarely varicose except on the left side.

A violent physical strain may induce acute varicocele.

Pathology.—In mild cases the veins are merely tortuous and dilated. But in a full-formed varicocele the vessels are elongated, their valves broken down, their walls affected by fatty atrophy, and thickened. The veins sometimes contain phleboliths, or become thrombosed throughout, as a result of chronic phlebitis.

Symptoms.—I have seen a number of cases of *acute varicocele* resulting from straining.

Except in acute cases *varicocele comes on gradually* and is discovered by accident. The amount of *pain* complained of varies greatly; a very large varicocele is usually attended by absolutely no pain, while a very slight enlargement of the veins may give rise to considerable uneasiness extending up the back and down the thigh, perhaps amounting to neuralgia of the testis.

The only *general symptoms* of varicocele besides this dragging discomfort are those of hypochondria and defective *morale*. The impotence alleged by physicians of an incredible number of "years' experience" to result from varicocele is the veriest fiction. When impotence and varicocele coëxist they are due to the same causes; but neither is the impotence due to the varicocele nor the varicocele to the impotence.

The *local conditions* are typical. The left testicle hangs considerably lower than the right, borne down, and perhaps completely surrounded by the mass of dilated veins. The mass feels soft, like a bunch of earthworms. The scrotal veins may be similarly affected. The scrotum is thin and relaxed, the dartos powerless. In long-standing cases of severe varicocele the testis gradually atro-

phies because of the interference to its circulation. This result is not due to the weight of the mass of veins.

The *course* of the disease is usually not progressive. Of the many men who have slight varicocele, only the smallest percentage fail to get well under the regulated sexual exercise of married life.

Diagnosis.—There are few diseases more readily recognizable than varicocele; the peculiar appearance and wormy feel of large tortuous veins can scarcely be confounded with anything else.

The veins may become thrombosed. One would not suppose such a condition would be obscure, yet I have seen a whole hospital staff inhibited from diagnosing a most patent case.

Treatment.—If the varicocele be small and its symptoms inconsiderable, the patient should be advised as to his sexual hygiene, perhaps instructed to wear a suspensory bandage and treated for neuralgia of the testicle, if this is a feature of his condition. If these measures fail, or if the patient insists upon more radical treatment, surgery must be employed.

TUMORS OF THE CORD

Solid tumors of the cord are rare. Fibroma, fibromyoma, and sarcoma, all of the vas deferens, have been observed in isolated instances. Gumma is very rare (Goldenberg).[3] The only tumor of clinical importance is lipoma of the cord. The frequency of lipoma of a hernial sac lends color to the theory that lipoma of the cord is secondary to hernial lipoma. In structure the tumor may be a pure lipoma, a fibrolipoma, or a myxolipoma.

These tumors are usually small and reducible into the inguinal canal, simulating epiplocele, from which they are only differentiated by operation unless they can be drawn entirely out of the canal. Exceptionally, however, they attain an extraordinary size. Nové-Josserand[4] reports a specimen weighing 6½ kilos, and cites two others weighing respectively 20 and 15 pounds. The larger tumors may seem pathologically benign and yet prove clinically malignant. They are extremely rare. I have never seen one.

[3] *J. Cutan. & Genito.-Urin. Dis.*, 1901, xix, 113.
[4] *Lyon méd.*, 1897, lxxxiv, 237.

CHAPTER LXIII

DISEASES OF THE SEMINAL VESICLE

The functions of the vesicle are three:

1. To store the secretion of the testis
2. To dilute it
3. To expel it into the prostatic sinus just before ejaculation

1. In rats, guinea-pigs, and some other mammals, the vesicles empty by a separate duct into the urogenital sinus and at no time contain spermatozoa. In man injection of the vas deferens fills the vesicle with fluid before the ejaculatory duct is forced open. Hence it is fair to assume that the vesicle, as well as the ampulla of the vas, is a place of storage for the spermatozoa.

2. The *secretion* of the seminal vesicle dilutes the semen and probably has some obscure function of stimulating the vitality of the spermatozoa. This secretion is albuminous, alkaline, and odorless. It contains a large proportion of mucin. Besides blood-cells, leukocytes, and epithelia, the fluid contains many little hyaline pellets rarely visible to the naked eye. These bodies (sympexions, globulin körner) appear under the microscope as hyaline spheroids showing radiating lines of cleavage. They may contain masses of spermatozoa or pigment granules, and may attain a size sufficient to obstruct the ejaculatory duct.

3. The vesicle becomes distended with fluid by the accumulation of its own secretion and the influx of spermatozoa. Little or none of this fluid escapes, except during the sexual orgasm. This act occurs as follows: after a period of sexual excitement, during which the verumontanum becomes erect, the muscular coat of the vesicle and the ampulla of the vas contract peristaltically, driving the fluid into the ejaculatory duct, which, very probably, is relieved of the elastic pressure that usually occludes it by a simultaneous muscular contraction of the prostate. The semen is thus ejaculated into the prostatic sinus, where it mingles with the prostatic secretion. Thence the prostatic and urethral muscles eject the fluid by jets. Regurgitation of semen into the bladder is prevented, not by the erect verumontanum but by the force of the stream issuing from the ejaculatory ducts.

Science and experience agree that the seminal vesicles are not emptied by a single orgasm.

It is not proven that the vesicles have an internal secretion.

ANOMALIES

Anomalies of the seminal vesicles are usually part of some general genital malformation. When the vesicle is absent the corresponding testicle may yet be present. Extreme dilatation of the vesicles is probably always acquired.

The ejaculatory ducts may empty into the ureters instead of on the edge of the prostatic utricle. In a few cases they have been found to continue forward alongside of the urethra the whole length of that canal to the meatus.

WOUNDS OF THE VESICLE

Guelliot recorded only one case of undoubted accidental wound of the vesicle. The patient had suffered a fracture of the ischium.

Operative wounds of the ejaculatory ducts are very frequent. The potency of the ducts is imperiled by perineal lithotomy and prostatectomy. Two results follow: inflammation, occasioning acute vesiculitis and epididymitis, possibly, obstruction probably.

Fistulæ of the spermatic duct have resulted from the old-fashioned lateral lithotomy operations. The resultant spermatic fistula heals kindly unless the parts are cancerous or tuberculous.

CYSTS

Prolonged inflammation sometimes causes gradual dilatation of the vesicles until they become two or three times their normal size and even overlap in the median line. Such cysts have only a pathological significance.

Echinococcus cysts occurring between rectum and bladder have been attributed, without convincing proof, to the vesicle.

CONCRETIONS AND CALCULI

While it is not unusual to find a number of concretions or small calculi in the vesicles of the aged, they have, as a rule, no clinical symptoms. It is only very rarely that they give rise to spermatic colic or attain a noteworthy size.

Symptoms.—*Spermatic colic* may occur at the moment of ejaculation or during sleep. The pain is very sharp, colicky, in fact, and nauseating. It is centralized about an inch up the rectum, or at the neck of the bladder, and thence radiates up the posterior wall of the pelvis or to the testicles. The pain is caused by the impaction of a concretion or a mass of inspissated semen in the duct. The obstruction may be forced, and a painful and deficient emission ensue after a few moments of colic, or, if it occur without sexual sensations, during the night, it lasts from ten to twenty minutes and then gradually dies away.

Treatment.—The hot rectal douche is an excellent remedy to relieve the pain and to shorten the attack. Many persons who are subject to mild attacks of nocturnal spermatic colic obtain relief by introducing a finger into the rectum and pressing upon the offending organ.

Relapses are discouraged by massage of the vesicle.

VESICULITIS

(See Chap. XX.)

EXAMINATION OF THE VESICLE

(See Chap. II.)

NEOPLASMS

The seminal vesicle becomes involved in malignant neoplasms arising in its vicinity, notably those of the prostate and the bladder. No primary neoplasm of the vesicle has been proven to exist. Guellot's famous case was evidently prostatic in origin.

CHAPTER LXIV

DERANGEMENTS OF THE MALE GENITAL FUNCTION

When the urologist is faced with a problem in sexual strategy based upon inversion or perversion of the sex instinct he should realize that, in spite of any curious interest he may have in the details of the patient's story, it is nevertheless his duty to send the victim on to the psychiatrist. But minor abnormalities in sex so intertwine themselves among the phenomena of many urethral diseases that, whether the urologist likes it or not, he must be familiar with them in order to do justice to his patients.

What is normal sex? Like any other normal appetite it is that which ministers to the finest life possible to a given individual.

For sex is fundamentally individual. What is a normal sex life for me is not a normal life for you. There are more sexual gluttons in the world than sexual vegetarians and the curiosity and vigor of flaming youth pass into the disillusionment of age through days almost every one of which seems bent upon dragging our ideals in the mud. Yet if there is any quality that distinguishes the wise old physician it is a mellow idealism that in the face of the daily discouragements of his own life, wherein performance is never quite as perfect as could be wished, he is never afraid to hold up to his patients the frank ideals of a cleaner life than it would seem possible for them to aspire to. Never dim the flame of the strictest morality you can imagine, and you will time and again be delighted at the responsive glow aroused in the most unpromising material. The consultation is a solemn moment to your patient. Under its influence he will find himself confessing to a spirit he may well have thought long since forgotten. This is sound morality because it is sound physiology. It is just as much the physician's affair to mend the patient's body by helping him to forego sexual excess as by encouraging him to stop drinking himself to death.

In the relation between physician and patient honesty is the best policy. The patient, however dishonest he may be under the pride and prudery that haunt his relations with his own physician, is sufficiently alarmed to come out with the truth when he reaches the specialist. It were a shame to the profession that dishonesty should face him. But, alas, the physician is not under the mental stress that came near to making us all honest in the trenches. The "Come again" spirit, child of vanity and greed, may doom to failure the most promising psychic negotiations.

For the sex problem is always a psychic one. Were man truly normal he would welcome relief from the goad of sex. He comes to his physician seeking reassurance and a little common sense, or to be put in training for some

dreamed-of sexual conquest, or for a hasty stimulant before the gong rings for the next round.

Hence the essentially psychic basis of successful therapy, viz., to find out what the patient wishes, not what he needs, and either obtain it for him or explain to him why he may not expect to attain it, incidentally diverting his mind to ambitions at least one degree less animal than those that have led him to the consultation.

Sex Life.—Description of what I might consider a normal sex life would, I hope and believe, not only leave me in hopeless disagreement with my peers, but even with myself. For I have yet to know the male who has constantly subjected his sexual functions to minister to the best and finest life possible to him. Indeed, coming down to a more human plane, one can only dimly understand the sexual life of persons whose sex or race differ from his own. Men of the North European stock living in the northern part of the country seem to have the following sexual experiences:

In infancy occasional nocturnal erections occur, their frequency encouraged by phimosis, genital pruritus, etc., or through titillation by the nurse. Infantile masturbation may result, even in a normal child and with no obvious reason.

While still preadolescent the youngster encounters the denied mystery of sex. It will require all the wisdom and tact of the most sympathetic parent to interpret the beauty of that which the child's companions express only in terms of vulgarity and brutality. A formal and self-conscious lecture covering what the parent conceives to be the child's difficulties will often only leave the child vaguely suspicious of the parent's sexual taboo. Sex education of the child is essentially a matter of example. The boy of the casual divorcée is almost inevitably predestined to sexual damnation by the example of his elders. The formal lecture will not mend matters. The reticent child resents the intrusion, the canny child remains cynical, the brutal child unmoved, the sensitive and ignorant scandalized. The vigor of the sex instinct and of the child's powers of control are hereditary, but the vigor with which he will apply the brake rests upon his enthusiasm in support of the idealism he encounters in his school or home. Consider Bertrand Russell's views, which I quote at length. They are not wholly my own but are those of a respected modern authority on philosophy and psychology.

"It is, of course, evident that if the right effect is to be produced, they (children) must not, at any age, be left under the charge of people whose outlook is wrong. The most highly trained nurses have been taught to deal with masturbation in a manner calculated to produce insanity. And the foundations of deceitfulness in later life are laid when a child is taught, in the name of decency, to be furtive about evacuation. Moreover, the usual motive to which ignorant women appeal in trying to produce right conduct is terror; thus the child comes to think that acts inspired by fear are better than those inspired by adventurousness. This produces a timorous adult, incapable of

independent thought or feeling, and anxious only to escape the censure of neighbors. . . .

"Children should not at any age be taught that certain parts of the body are peculiar. In a civilized community there would be no such thing as 'decency,' which is merely an externalization of indecency in thought and feeling. . . . We all, however virtuous and prudish, think a great deal more about sex than we should if we had been brought up freely. Children should see each other [from infancy on] and their parents naked whenever it so happens, and they should observe that their parents do not mind being naked before each other. But they should not see too much affection between their parents, as this gives rise to feelings of jealousy. . . .

"Questions about sexual matters must be answered in the same tone of voice, and with the same manner, as any other questions. It will then be found that the interest in the subject is vastly less than the interest in trains and aëroplanes. I have found in both my own children great interest in the fact that children grow inside their own mothers, because they feel that this is a fact about their own early lives. My boy, five and a half, knows that a seed comes from the father into the mother, but the fact does not interest him, and he has not yet asked how it is planted. When he asks, he will be told, but so far he has shown no signs of wanting to know.

"I do not believe in teaching children about 'sacredness' of motherhood or anything else. . . .

"I have not attempted to deal with the problems that arise after puberty and before the boy or girl is fully adult. These are difficult problems about which I have as yet not much experience of modern methods. I know the appalling misery I went through myself in those years, owing to an old-fashioned education, and I know that the evil effects have pursued me down to the present day. I find that large numbers of men and women say the same thing. . . ." [1]

With which he leaves us no further suggestions. Perhaps we might all be wise to recognize that the rest of social hygiene is still experimental. The attempt is being made to interweave the topic of sex into the curriculum of the school so that advance in the knowledge of the subject will be almost insensible and always guided. May it prosper.[2]

On reaching puberty the average youth begins to masturbate. Few do not. A sound social atmosphere, not necessarily a cultured one, and the ascetic spirit of athletics do more than anything else to divert him from the habit. He must also continue to find his parents practicing rather than teaching a formal moral code. Some religion, some binding with the eternal verities, he needs for his length of days.

At this period his nocturnal emissions of semen are likely to occur several nights a week, perhaps nightly, perhaps several times a night, with remissions.

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[1] *New Republic,* Nov. 16, 1927, Children's Book Section.

[2] Consult American Social Hygiene Society, 370 Seventh Avenue, New York City.

Frequent mental and physical masturbation is the occasion of a chronic congestion of the verumontanum that is the cause of most excessive involuntary pollution, but not of all. Nor is the bashfulness of adolescence, or its limp anemic specimens, attributable exclusively to this. Faced with a case, one had better investigate than dogmatize. One may recognize that the youth is aware of the unsocial character of his acts, and his boldness is not increased thereby. But what the youth needs is neither terrorization nor physical treatment. He should be shown that he is not greatly different from every one else, indeed, is in the grand tradition, but that in order not to lose his chances in life he must do as other boys do, and down his habit, letting his emissions have their run. Let him repeatedly "go to confession" to his physical advisor that the responsibility for the situation may be removed from his shoulders.

With the middle teens and the spontaneous development of hetero-erotism, the individual becomes more defined. His moral stamina, his health, his common sense and the soundness of the basis upon which his ideals are built combine with accidental circumstances to determine the age at which he has his first illicit sexual relations, or whether he escapes these altogether. The psychological tendency to masturbate no longer exists. Only habit holds those who continue to do so. I should like to know how many men with vigorous sexual impulse have either not masturbated at all, or have given up the habit without replacing it by any physical substitute. I have known a sufficient number of them to realize that, though neither the cursers nor the whiners, they are numerous among the great average "silent vote."

The force of the sex impulse reaches its maximum between the ages of twenty and twenty-five. Thereafter it weakens, though habit and false ideals may artificially stimulate it many a year. Standards are quaint and not to be compared. I once accused a patient of having no ideals. "You are quite mistaken," he replied, "my ideal is to write a great melodrama."

MASTURBATION

It may be safely assumed that a large proportion of mankind has masturbated more or less at some period in their lives, and it is equally safe to assert that at least 90 per cent of such masturbators are not physically injured by the habit. If carried to excess, sexual indulgence in the natural way will produce evil effects, yet sexual intercourse is not only harmless, but even beneficial in moderation, as it can be only in the married state. It is not the loss of seminal fluid which is of the first importance in producing disease from sexual excess, but the nervous shock of the oft-repeated orgasm. Babies and young children lose no seminal fluid, women have none to lose; yet, in all of these, evil results follow excess as certainly as they do in the male after puberty. It is probable that any succession of nervous shocks as sharp and decisive as the sexual orgasm, even although purely intellectual, such as joy or fear, would shatter the vitality and nervous tone of an individual as much as masturbation.

Such writers as Lallemand, Acton, Belliol, make too much of the solitary vice, while quacks find here the largest and most lucrative field for their nostrums. These men scatter their books and circulars broadcast over the land, and often, under alluring titles, thrust them within the eager grasp of the young, the inexperienced, the hypochondriacal, the nervous, overworked, unmarried youth, whose sexual needs, stimulated by his impure thoughts, find no adequate relief. Their tenets find ample faith and ready acceptance in the ingenuous mind, and errors are implanted which years of sober after-thought and experience, aided by the physician's careful and conscientious advice, are scarcely able to eradicate.

The use of tobacco, alcohol, and, it might be added, tea, is as widespread as the habit of masturbation; and each of these, or certainly the first two habits, probably inflicts as much injury upon the human race as does the secret vice. Yet who would affirm that every man who smoked would have headache, dyspepsia, heartburn, neuralgia, intermitting pulse, or would become thin, depressed, nervous, sleepless—all of which effects may be produced by an excess of tobacco; or that another who drank liquor would necessarily have delirium tremens, cirrhosis of the liver and kidney, and die with ascites and Bright's disease? As with whisky and tobacco, so it is with masturbation carried to excess. Masturbation may contribute in producing the most serious results, among which idiocy, insanity, epilepsy, dementia, physical prostration, hypochondria, impotence, and sterility are prominent; but in such it will be found that some mental deficiency was the fundamental difficulty, masturbation but one of its expressions. Hence it is evident that, while the intelligent physician must recognize the physical evils masturbation may produce, he should boldly oppose himself to that sickly sentimentality which shrouds in mystery one of the failings of our physical nature because it involves the sexual function, and should try to face the subject honestly and to handle it as a scientific problem.

The majority of mankind who indulge in masturbation do so just before and after puberty. At first most of them are ignorant that they are harming themselves, but they soon find it out by one means or another, and then sooner or later give it up. The longer and the more frequently they yield to the vicious habit the stronger does its hold become, so that in case they escape the mental and physical disorders to which excessive venery in extreme cases may give rise, still they may pay the penalty of excess by some diminution of vigor in after-life, by upsetting their sexual hygiene, and by establishing sexual necessities which they find it difficult to satisfy; and, finally, they may continue on through life victims to a perverted sexual sense, shunning women, from whom they aver that they derive no pleasure, totally wrecked as to their *morale,* hypochondriacal, and suffering from all sorts of functional distress, physical and intellectual, real and fancied.

The chief reason why so much is said of venereal excess by masturbation, and so little of sexual excess in the natural way, is that the former is so much more common, and not that the act itself is physically more harmful. The

solitary vice, as it is aptly styled, may be practiced on all occasions. On the other hand, sexual intercourse requires the consent of two individuals and opportunities which are comparatively hard to find.

In married life excess is the exception; sexual hygiene is more apt to be correct, man is in his natural condition. Other emotions enter largely into his daily life, and it is rare that a man happily married complains of any disorder of the genito-urinary system, except those of a purely physical nature. On the other hand, the old rounder, who flatters himself upon the number of women he has ruined, but lays the blame upon Dame Nature, is usually a masturbator and, not infrequently, a pervert.

A young child who has been taught to masturbate will be seen constantly at work at his genitals, and observed to have erections with unnatural frequency. No further signs are needed. Such children are fretful, peevish, thin, nervous, excitable, sleep badly, and have a haggard look.

Boys who masturbate to excess usually incline to melancholy broodings, to staying apart and reading rather than to joining their companions at play. Their palms are apt to be cold and moist. They lose the innocent frankness of youth.

The young man is overshy, unambitious, he shrinks from a steady gaze, blushes readily, and seems to be conscious of having done something unmanly.

Adult masturbators often show no sign of the habit, though they are apt to be cowardly, mean-spirited, physically inhibited specimens of humanity. But it is rare for adults to practice masturbation to great excess, and, if they suffer from any of the supposed evil consequences of the habit, it is either on account of excess in earlier life, of imperfect sexual hygiene, or of irregularly gratified sexual desire. Their symptoms are generally hypochondriacal, and manifestly not entirely dependent upon masturbation for the same symptoms are very common in patients who do not masturbate. As to atrophy of the genitals, varicocele, etc., these are not due to masturbation. Masturbation is a symptom, not a cause, of that lack of self-control which is insanity.

The physical damage done by masturbation, or any other form of sexual excess, is confined to the internal genitals. Its most patent expression is verumontanitis.

The foregoing remarks are not intended to palliate in the least degree the baseness of the practice of self-abuse, or to deny that lack of physical and sexual vigor, spermatorrhea, neuralgia of the urethra, etc., may be caused by its excessive indulgence; but they are intended to combat the prevalent idea that very few men indulge in the secret vice, and that all who do so suffer; and they are also intended to advance the proposition that in the vast majority of instances masturbation does little harm to the individual, except in regard to his *morale*. It unmans him, makes him untrue to himself, and cowardly; and most sensible boys find this out before a great while, and give up the practice, which they feel to be sapping their manhood and self-esteem.

It is infinitely better that a boy should never masturbate if he can be pre-

vented. Prophylactic, inspirational instruction may save him. No instructor can equal a parent, whose moral influence outweighs all consideration of amateurishness. Every child has a right to know the essentials of sexual life. Indeed, every boy, at least, will learn from an evil source all he fails to learn from a pure one.

The parent's chief duties are two, viz., to answer all questions with absolute frankness, for they are asked in that mood, and to warn the child of approaching phenomena of emissions, etc., as well as of the need of keeping his hands off his own genitals and those of others.

Nurses should be watched and discharged if they are found handling the child. If the infant has already acquired the habit, his hands must be tied when he sleeps, and at all times he must be watched until he grows out of the habit. Circumcision often helps to check masturbation whether of boy or girl.

In most cases it is not good policy to ask a boy if he fingers his privates. He will be pretty sure to say no, and then to tell other lies to substantiate the first. To assume the fact after a careful study of the case is the safest course, and the boy, thrown off his guard by the statement that he does masturbate, will rarely deny it, or will do so in such a lame manner or with such overpositiveness as to convict himself. Finally, when he has confessed his folly, it is not wise to terrify him out of his habit by brilliant and exaggerated statements of the possible misery he may bring upon himself if he does not desist. This is appealing to a base motive, and, although sometimes successful, it is often inadequate to the proposed end, for a healthy boy cannot realize what it means to be sick; he cannot understand it, and consequently is not afraid of it. The method of treatment that is most effective, but requires the most force to carry out, is to elevate the boy out of his bad habit, to shame him, to make a man of him, to reason with him, and to talk to him honestly and openly, without reserve or mysticism.

When a man comes complaining of the results of masturbation, an attentive study of the symptoms will prove his disease to be hypochondria, and his malady ungratified sexual desire, often with congestion of the verumontanum. His training should consist in encouragement to continence, with absolute purity of thought, and subsequently marriage, to regulate his sexual hygiene. After marriage we hear no further complaint from these cases, always provided there is really nothing more than functional derangement at the bottom of the patient's complaint, as is the case in the vast majority of instances.

The physical treatment should be directed toward lessening the sensibility of the veru, as for impotence.

IMPOTENCE

So long as nocturnal emissions do not unduly occupy the mind they should be made little of and the thoughts diverted by other occupation, notably by the

invigorating stimulus of athletics. No medication is known to affect their frequency, except it be a direct attack upon the chronically congested or inflamed verumontanum. This attack should be deferred in part because it has the unfortunate psychological effect of focusing the patient's attention still further upon his genitals and in part because no local attack guarantees to check the emissions. Failure of a treatment that distracts the patient's mind from sex is unfortunate, but failure of an attack upon the genitals themselves is disastrous.

Each specialist has his own favorite formula for treatment. Their number attests their fallibility. Try to make hygiene and psychology dominate the picture. I never guarantee success from local treatment. I attempt to plumb the patient's sexual ideals, habits and history before beginning local treatment.

The object of local treatment is to decongest the prostate and particularly the verumontanum. For the prostate one should overcome constipation, massage the gland once or twice a week and order the patient to take daily hot rectal irrigations. I have had no luck with diathermy.

For the verumontanum one must begin gently. Many of these men have an exquisite general sensitiveness of the genitals. If this exists it must be deadened by repeated gentle passage of a sound after local anesthesia until the patient is prepared to permit the passage of an instrument without anesthesia. Then, after the passage of a sound, a single drop of 1 per cent phenol is instilled on the verumontanum. This treatment is repeated twice a week until the patient does not complain of the burning from 5 per cent. Then shift to 1:1,000 silver nitrate, one drop. At about this time it is as well to omit the sound while continuing the massage. In this one is guided by the patient's report. The strength of the solution is doubled at each visit until the patient declares that he suffers unduly. On reaching 1:500, the interval is made once a week. If 1 per cent is reached without adequate benefit one proceeds to apply 20 per cent silver directly to the verumontanum through the urethroscope once in two weeks. Some prefer mild fulguration with the Oudin current. The verumontanum is swollen at first and should appear smaller as treatment proceeds.

Meanwhile the patient has been doing his utmost to keep his mind and body "out of temptation." If he is unable to appreciate the virtue of continence, if he cannot realize the value of preserving his life in terms of spiritual integrity, intellectual acumen and bodily strength, one spares one's self defeat and the patient despair by permitting him to consult some one more sympathetic.

Should a month of such treatment fail, it should be discontinued. Matrimony may intervene to save the day, but it cannot be prescribed like a pill. Casual sex relations do not take the place of matrimony, for the debauch, the competitive stimulation of the imagination that they imply, fosters that very concentration of ambition and life on the cheap vanity of the worship of Priapus and thereby hastens and intensifies the premature ejaculations.

Premature Ejaculations.—The chronic congestion of the verumontanum that is first expressed in nocturnal emissions leads to premature ejaculations of semen. The duration of erection becomes less and less until finally the emis-

sion occurs before intromission and finally without any erection at all. The slightest irritation, such as the vibration of a trolley car, occasions emission. When this state is reached, treatment seems of no avail.

If the patient is married he may often cure himself of premature ejaculation by avoiding every possible suggestion of sex, by sleeping in a different room or at least in a different bed from his wife, and attempting sexual intercourse as infrequently as possible and only on condition that he has a firm erection and that his wife will permit access before that erection fails. He must have wit enough to study his state dispassionately, learn the conditions under which he does best and make every attempt at intercourse as successful as possible, thus breaking the habit of failure and dispelling that dread of it which is psychologically at the bottom of the difficulty.

Indeed, fear dominates the picture always. The patient realizes that he makes a sorry spectacle and this mortification of his masculine vanity adds to his psychic impotence and stimulates him to repeated efforts that only hasten the decay of his powers. He soon learns that though his first ejaculation is premature the second is a more satisfactory performance. The strain to accomplish this hastens the weakness. He discards the first ejaculation, as it were, and counts for mutual gratification upon the second, the third, perhaps. It cannot be said that repetition of the sexual act several times in the twenty-four hours is destructive of the powers of the normal man, else were we all in a bad way. A strain it certainly is, but no more of a physiological strain than a severe tennis match. Either, too often repeated, will destroy the function, to play tennis, to cohabit. But weakened sexual power will not stand this strain. Hence the patient with premature ejaculation must never repeat. He must depend upon the first ejaculation. Unless he can learn to defer this, his sexual capacity is doomed.

The situation of the unmarried man with premature ejaculations is far more difficult. If he seeks help early he must be persuaded, much against his will, that his only hope lies in the repression of all immediate sexual ambition and of all occasions to sexual thoughts until hygiene and local treatment shall have reduced the congestion of his verumontanum. If the habit of premature ejaculation is really fixed, he must look forward to a probation of at least a year, perhaps of several years, before he may hope for improvement. Intelligent and conservative psychotherapy may help. Endocrine treatment seems as yet to have no more than a psychic effect and the same is true of gland implantation, yohimbin, damiana, etc. Yet the history of Brown-Sequard and Steinach shows how much may be expected from even unsound psychotherapy. Patients insist upon being deceived. We all lack common sense in spots, and the horror of imagined sexual incapacity drives man from his proper senses.

Casual experimental sexual relations are more disastrous to the patient with premature ejaculations than to him who suffers only from nocturnal emissions. If the patient is engaged to marry, the only condition under which this may be permitted is that the affianced be informed of the situation by the medical ad-

visor and made to understand that if she marries this man sexual relations will probably prove impracticable and that children, if to be expected at all, can doubtless be obtained only by injection into the vagina of semen from a condom. A woman inexperienced in sexual fact could scarcely be expected to weigh such a situation intelligently. Yet I know several happy marriages thus founded; two of them fertile and one that has proven normal.

Failure of Erection.—After premature ejaculation has been definitely established the erections begin to fail. For most men who complain of failure of erection independently of premature ejaculation are merely frightened individuals whose ambition outruns performance. A man may be expected to admit that his stomach is weak or that his legs are not what they used to be, but he loves to flatter himself that his sexual powers are both indestructible and immortal. They are neither, and the cure of many a case of so-called impotence consists in the explanation of this situation.

Sexual prowess is doubtless an endocrine endowment, though its nature is not wholly clear. It is not related to fertility. As a basis for the study of a case of impotence it is essential to know the patient's past sexual history in order to estimate his native vigor. In so doing we come upon the curious fact that sexual reticence has little to do with vigor. The man of congenitally low potency may remain celibate in every sense or come virginal to his marriage bed, only then discovering that his interest in the physical relation of sex is much milder than those of his fellows. At that, he makes the most satisfactory husband for the average woman. After a time erections are weak and the husband finds himself at thirty no more ardent than the average man at sixty.

Such slight sexual equipment may be recognized in a young man by the fact that he is not natively ardent (and the artificial, behind-the-barn ardor must be distinguished), has few nocturnal erections and is not of the adrenal type. The world would be a happier but a less merry place if we were all like him.

Such men, like their more potent brethren, must cut their cloth to suit their figures. The same is true of the aging male who would have us play Mephistopheles to his Faust. One does not feel bound in conscience to pander to the prurience of senility.

Treatment.—The treatment of functional impotence may therefore be thus summarized:

1. *The Patient's Sexual Coefficient Must Be Discovered.*—The sexual coefficient is the amount of sexual power with which he is endowed by Nature. Mankind at large is possessed of the notion that, although men's noses and digestions need not all be cut of the same pattern, it is to be expected that the sexual capacity of everyone should be all-embracing. Thus, while it is no disgrace to be dyspeptic about the stomach, it is to the last degree shameful to be dyspeptic about the genitals. Theoretically, such a distinction is absurd; but practically, no man is willing to brand himself a sexual laggard. In some way, by dint of enumerating emissions, copulations, masturbations, the physician must learn what program he may set before the patient. If a man's natural capacity for

sexual congress is only once a month, it is hopeless to try and tune him up to three times a night.

2. *The Patient Must Be Encouraged.*—The first point of encouragement must be to depress him by bidding him look for a protracted and relapsing convalescence. Then he must be made to understand that his sexual possibilities are just so great and no greater; and that, however well he may get, overstepping his allotted bounds will call down swift retribution upon him. Finally, he must really be encouraged to feel that his malady is a functional disorder, a dyspepsia, which, like other dyspepsias, is curable, but only at the cost of a prolonged fast. He must abstain from coitus, from masturbation, from lewd companions, from obscene thoughts and things. The more thoroughly he abstains, the more certain his cure. Usually he will try to adopt halfway measures, caring more for his "pot of ale" than for body and soul together. But such a course may not be countenanced. The ideal of absolute renunciation must be forever set before him and, as it were, hammered into him. If a strong moral influence, as that of father, brother, or priest, can be brought to bear, so much the better.

But all these measures are frankly palliative. When a man has once got into the habit of concentrating his whole mind upon his sexual organs, it is not to be expected that he should be entirely diverted to higher things. Celibacy all can aim at, but chastity is beyond the reach, beyond even the understanding, of the many. Hence, the proper cure for such a man, if he can be got into such a condition that he has an erection ever so rarely, is to instruct him in sexual physiology and hygiene, to acquire his confidence by sympathy, and if he is married, to advise him to attempt no intercourse, to be entirely frank and honest with his wife, who will more than equal him in timidity and ignorance, and, awaiting some morning when awaking with a vigorous erection, to accomplish coitus promptly without delay, as a matter of imperious duty. The act once accomplished, the spell is broken. He knows he is a man and his confidence in himself returns.

3. *He Must Be Assisted Physically.*—When possible, an entire change of scene with hard physical work presents the best opportunity for a man to get out of his old rut.

Local treatment of the urethra by instillations, urethroscopic cauterization, massage of prostate and vesicles, sounds, etc., quite empirically, as in the treatment of sexual neurasthenia.

Hühner speaks well of bromids, 1 gram, p. c., and 0.0025 (1 : 20 grain) of strychnin in four doses, every two hours, immediately preceding intercourse.

Endocrine therapy offers as yet more promise than proof of adequacy.

STERILITY IN THE MALE

Sterility is an inability to beget children on account of absence or imperfection of the semen.

The spermatic fluid, though ejaculated, may contain no spermatozoa (*azoöspermia*). Without enumerating all the possible causes of azoöspermia, five may be especially designated:

1. Obliteration of both epididymes or both vasa by inflammation.

2. Such temporary influences as debilitating disease and mental or physical exhaustion. The latter is the cause of temporary sterility in many business men. They can impregnate their wives only after a vacation has supplied them with surplus energy. Chemical toxemias may produce the same result, and although alcoholics are famous for having large families, Simmons [3] estimates that 61 per cent of alcoholics are sterile.

3. The x-ray [4] deserves special mention. Brief exposure to this may entail brief sterility. The constant exposure to the influence of the ray to which radiographers used to be subjected resulted in a prolonged and perhaps a permanent sterility.

4. Inflammation of the prostate and vesicles.

5. Congenital azoöspermia, usually associated with cryptorchidism but sometimes not accompanied by any recognizable defect.

Oligospermia is a rare and apparently congenital condition in which the semen instead of swarming with spermatozoa contains but few of these. They are usually deformed. Such a condition entails sterility just as much as does azoöspermia. Its cause is not known.

Aspermia means absence of ejaculation owing to deformity or scar about the orifices of the ejaculatory ducts; these project the semen backward into the bladder instead of outward along the urethra. The patient recognizes no ejaculation, but usually there is a slight seepage from the meatus and such patients are by no means inevitably sterile.

Diagnosis.—The diagnosis of sterility is a much more complex problem than the above paragraphs suggest, for the problem includes, not only the question of masculine, but also that of feminine sterility. Moreover sterility is often relative. The diagnosis of sterility, due to such gross lesions as azoöspermia, oligospermia or aspermia, is readily accomplished by the examination of a condom specimen. The difficult problem is that in which both man and woman are apparently normal though their union remains infertile. *Careful microscopic examination of at least two condom specimens of semen is the first step in diagnosis.* The chief information obtained by such an examination is the number of spermatozoa. If these are very numerous the semen is doubtless fertile unless many of the spermatozoa are deformed. Indeed it is usually a waste of time to endeavor to estimate the motility of the spermatozoa in a condom specimen. This can only be fairly studied by an examination of the secretions in the woman's vagina a few hours after coitus. Reynolds,[5] basing his work on that of Hühner,[6] comes to the following conclusions:

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[3] *Deutsch. Archiv. f. klin. Med.*, 1898, lxi, 412.

[4] *Cf.* Brown and Osgood, *Tr. Am. Ass. Genito-Urin. Surg.*, 1907, ii, 365.

[5] *J. Am. M. Ass.*, 1915, lxv, 1151.

[6] *Sterility*, 1913.

"1. When the spermatozoa are abundant in number, normal in form and appearance, furnished with long cilia and capable of rapid movement through the semen the male is satisfactorily fertile.

"2. When normal spermatozoa are killed or lose vitality overrapidly in the secretions of the individual woman the chemicophysiologic character of her secretions furnishes an effective cause of sterility.

"3. The alterations in a secretion which make it fatal to the spermatozoön may be localized in the vagina, in the cervix, in the body of the uterus, or in one or both tubes; and any one of these alterations may exist with normal secretions above it; but an alteration in the secreting surface in any of these localities usually vitiates all the secretions below it, probably by their necessary admixture.

"4. When the spermatozoa are observed to penetrate without apparent loss of vitality to the fundus of the uterus and to survive there for a normal length of time, deficient quality of the ova may be considered the probable cause of the sterility.

"Throughout the management of every case of sterility it must be remembered that the failure is the failure not of one individual, but of a couple, and that the condition of both partners must be studied.

"For the performance of the Hühner test we must ask to see the woman as soon as possible after coitus has taken place. She may come to the office for this examination, since it is only very exceptionally, if ever, that the vagina does not contain sufficient spermatozoa for this test even after she has walked about for some time. With a normal vaginal secretion the spermatozoa should show active motility in the vagina for about an hour and sometimes much longer, but if circumstances permit it is desirable that the patient should be seen within half an hour of coitus. A specimen of the vaginal mucus is taken by a sterile platinum wire from the culdesac, exposed by a speculum, and this examination may be repeated if desired, whenever convenience permits, until the spermatozoa are found to have lost their activity. A specimen of the cervical mucus is next obtained in the same way, after the surface of the cervix has first been carefully wiped clean of semen by the repeated use of cotton swabs, when no antiseptic should be used. With a normal cervical secretion and a normal os a few spermatozoa will usually be found in the lower part of the cervical cavity almost immediately after coitus, but will appear there in larger numbers at the end of half an hour to an hour. They are never so numerous here as in the vagina, but under normal circumstances, at the end of an hour, there should be several actively moving spermatozoa in each slide from the cervical mucus. The greatest care should be used to avoid the infliction of any trauma in the examination of the cervical cavity, since overthoroughness here may readily vitiate the use of the remaining portion of the test at that sitting.

"When the cervical cavity has not been unduly disturbed, when the spermatozoa are of full vitality, and when the secretions of the woman are normal throughout, an examination of the secretions of the cavity of the uterine body should disclose the presence of a few actively motile spermatozoa in the uterine

mucus at the end of from two to three or four hours. This examination must, however, be made with a specially devised syringe, since the platinum loop can neither be introduced with certainty to the fundus nor made to retain the uterine mucus during its withdrawal from the cervix. Even with the use of a syringe it is difficult to be absolutely sure that spermatozoa which are observed in the fluid withdrawn from the uterus are not due to an admixture from the cervix, but if the piston is not withdrawn until the tip of the syringe is well up in the uterine cavity, if the outside of the syringe is carefully wiped after withdrawal, if it is properly designed, and especially if the spermatozoa are found several times in succession, their probable location in the uterine mucus can be predicated. In some cases it will be found that actively motile spermatozoa have disappeared from the cervix after the lapse of a number of hours but are still found in the uterine mucus. In these cases the test is practically complete."

The saddest commentary upon the prevalent state of the medical mind in reference to the diagnosis of sterility is reported by Barney.[7] He collected statistics from a large public hospital on 108 women who were diagnosed as sterile; seventy-four of them were actually operated upon, or advised to be operated upon, and yet only five of the whole number had the husband's semen examined.

Treatment.—Ten per cent of sterility is said to be due to the male, and it is only with the treatment of sterility in the male that we shall concern ourselves. I can recall only three classes of cases that have consulted me:

1. Aspermia after operation is likely to be only temporary, or at worst partial. I have twice tried to correct it by operation, but have not succeeded. It is, as above stated, not an inevitable cause of sterility.

2. Azoöspermia due to alcohol or overwork. Cases of the latter sort are, I believe, not infrequent. I have twice seen impregnation follow a vacation in Europe; one of these couples had been married five years, the other twenty. In both the semen was apparently normal while the husbands were at work, and the wives had been duly and vainly mutilated by the gynecologist.

3. Azoöspermia, due to bilateral gonorrheal epididymitis. For these the proper treatment is the Martin operation; without it there is no hope, with it there is a small prospect of cure, perhaps 10 per cent.

I have never seen a case in which the vitality of the semen was proven to be interfered with by suppuration in the prostate or seminal vesicles. Many persons with chronic prostatitis and seminal vesiculitis have all the children they want. Oligospermia seems a more incurable condition than azoöspermia, for in the former case the deficiency is probably congenital though Martin regards it as a partial obstruction.

PRIAPISM

Priapism is a condition of prolonged erection independent of the will or emotion of the patient. Such erections may be transitory, in which case they

[7] *Boston M. & S. J.*, 1914, clxx, 943.

are usually due to some local inflammation or to cerebral or spinal disease, *e.g.*, tabes. But in severe cases the priapism may be of very long duration. Hinman [8] distinguishes the cases due to remote causes, and those due to local mechanical causes. Among the former three were due to peripheral irritation (phimosis, fissure in ano); four were toxic, three due to cantharides and one to diabetes; five due to nasal polypi and cured by their removal, thirteen to fracture of the spine, one to myelitis, and another to tumor of the spinal cord.

Among the cases due to mechanical cause, sixty-four followed sexual excess and in fifty-five of these there was thrombosis of the corpora cavernosa, six other cases of thrombosis followed a systemic infection, in two cases there was infiltration with neoplasm, while two others were attributed to angioneurosis. Injury produced the thrombosis in seven cases; "45 cases showed a definite relationship to leukemia."

Hinman states that priapism is most common between the twentieth and the fiftieth years, and that it may continue for from a few hours to two years. The nervous cases of functional origin are usually repetitious and brief. Pain may be absent or severe. There may be some disturbance of urination; sexual desire is usually absent. Many of the cases have got well spontaneously or by treatment of a recognized etiological factor. Hinman suggests operative relief by division or injection of the internal pudic nerve, by ligation of the dorsal arteries, or by dividing the ischiocavernosi muscles. For priapism due to thrombosis of the corpora cavernosa incision has been employed with success in thirty-one out of thirty-three cases. Hinman suggests that incision in one corpus is likely to drain both, since the vascular anastomosis is free.

I have had two cases of thrombosis. Both were relieved after what seemed at the time an inadequate evacuation of clots.

McKay [9] suggests that the clots may be evacuated by aspiration through a large caliber needle.

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[8] *Ann. Surg.*, December, 1914.
[9] *J. Urol.*, 1928, xix, 121.

CHAPTER LXV

DISEASES OF THE PENIS; ANATOMY; ANOMALIES; INJURIES; INFLAMMATIONS

ANATOMY

The penis is a genital organ. Its urinary function is purely secondary. It is conformed anatomically to subserve the genital function. In the adult it measures, when at rest, from the root of the scrotum to the meatus urinarius, from 6 to 10 cm. (2½ to 4 inches); when erect, from 12 to 17 cm. (5 to 7 inches). It consists essentially of three segments—the two corpora cavernosa, lying together like the barrels of a gun, and the corpus spongiosum, like the ramrod, beneath them (Fig. 172), the whole surrounded by integument.

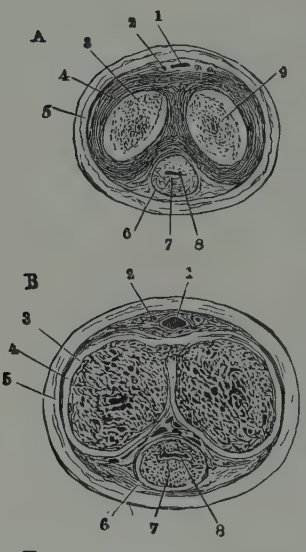

Fig. 172.—Transverse Sections of Penis.
A, Flaccid. *B*, In erection. 1,2, Dorsal vein and artery; 3, corpora cavernosea; 4, tunica albuginea; 5, Buck's fascia; 6, tunica albuginea of corpus spongiosum; 7, erectile tissue; 8, urethra. (Cruveilhier)

The Corpora Cavernosa.—The corpora cavernosa arise on each side from the tuberosities and ascending rami of the ischium. They come together under the symphysis pubis, and continue side by side, forming the main bulk of the penis. They terminate anteriorly in a conical extremity, over which the glans penis, the terminal expansion of the corpus spongiosum, fits like a cap. There is no vascular communication between the corpora cavernosa and the glans penis, or the corpus spongiosum.

The corpora cavernosa are surrounded by fibrous sheaths which are so dense and strong that they will support the weight of the cadaver. These sheaths are plentifully supplied with elastic fibers. The anterior portion of the partition between the corpora cavernosa is perforated by numerous apertures, to insure symmetrical erection. The tissue proper of the corpora cavernosa consists of large venous spaces, known as spongy or erectile.

The Corpus Spongiosum.—The corpus spongiosum urethræ is also composed of erectile tissue. It surrounds all that portion of the urethra lying in front of the triangular ligament, anteriorly forming the glans penis, which caps the conical extremity of the corpora cavernosa, posteriorly terminating in the

bulb, which lies just in front of the triangular ligament in the angle of the converging corpora cavernosa and below the urethra.

The Glans.—The glans penis is covered by a semimucous membrane endowed with peculiar sensibility, especially around the raised posterior border—the corona glandis. The epithelium covering the glans is fine, the papillæ minute, the sebaceous glands large and numerous, and most plentiful about the frenum. These glands secrete the white material (smegma) that collects behind the corona. The function of the glans penis is to furnish a soft-skinned expansion for the distribution of the terminal filaments of the nerves of sexual sensibility.

Muscular Action.—One important function of the corpus spongiosum is acquired through its bulb—namely, that of assisting in the expulsion of the last drops of urine or semen from the urethra. The prostate, the levator ani, and the deep urethral muscles—especially the compressor urethræ—contract upon the fluid remaining in the canal after micturition in a spasmodic "piston-stroke." This forces the last few drops beyond the bulb of the urethra. Now the fibers of the accelerator urinæ surrounding the bulb and adjacent portions of the corpus cavernosum contract and drive the blood contained in the areolæ of the bulb forward along the corpus spongiosum, distending that body, and thus bringing the walls of the urethra more closely into contact in a progressive wave. If there is organic stricture the last few drops of urine do not escape promptly, but dribble away; for the scar tissue which constitutes stricture obliterates the areolæ of the erectile tissue and thus obstructs the free passage of the wave of blood along the corpus spongiosum.

Fascia.[1]—The three erectile bodies above described are surrounded by the fascial sheath of the penis (Fig. 60). This fascia, which is called Buck's fascia, arises from the symphysis pubis by a triangular bundle of fibers, the suspensory ligament of the penis, and from the pubic rami at the attachment of the anterior layer of the triangular ligament. Thence it runs forward, surrounding the corpora cavernosa and the corpus spongiosum in two separate compartments. The cavity of Buck's fascia is bounded anteriorly by the base of the glans penis and posteriorly by the triangular ligament. Colles' fascia begins also at the triangular ligament whence it extends forward as the deep layer of the superficial fascia to scrotum and penis and belly wall. Hence periurethral cellulitis and extravasation are habitually confined within these limits for an indefinite time, escaping where the fascia blends with that covering the pubes, and leaves a loophole into the subcutaneous tissue of the abdominal wall.

Vessels.—The lymphatics and veins of the penis run along the dorsum, and receive in their course, branches from the corpus spongiosum. The lymphatics lead mainly to glands lying along and above Poupart's ligament on each side. The arteries arise from the anterior trunk of the internal iliac, by way of the internal pudic.

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[1] Wesson, *J. Am. M. Ass.*, 1923, lxxxi, 2024.

Connective Tissue.—The connective tissue between the skin and Buck's fascia is very loose and elastic, and, like that of the eyelids, does not contain fat.

Skin.—The skin of the penis, except that it tends to become pigmented after puberty, does not differ essentially from ordinary integument. Over the glans penis it folds back upon itself, forming a non-adherent sheath, the prepuce, for the glans.

The Prepuce.—The prepuce is composed of two layers, an external, cutaneous and a more delicate, internal semimucous. The point of junction of these two is called the orifice of the prepuce. Between these layers is a very loose and elastic connective tissue, without fat, which permits the two surfaces to be entirely separated from each other, and the prepuce effaced, by drawing back the integument of the penis until the glans is entirely uncovered. The mucous layer of the prepuce is supplied with glands. It is much less elastic than the cutaneous layer.

The prepuce is attached to the lower angle of the meatus urinarius by a triangular fold of mucous membrane called the frenum preputii—analogous to the frenum linguæ. The frenum contains a small artery.

ANOMALIES OF THE PENIS

Double Penis.—Double penis is excessively rare. It is analogous to double uterus and vagina in the female, but by no means so common. Undoubtedly it is not so rare as the records of surgery imply, for the existence of this deformity naturally leads the patient to shun observation; and, as the defect is not necessarily accompanied by any injurious symptoms, he does not voluntarily subject himself to the inspection of a physician. Hence the cases usually reported accompany grosser malformations of fetal inclusion. The case reported in the first edition of this treatise [2] is a notable exception. Similar ones are reported by Lebrun.[3]

Torsion of the Penis—With epispadias and hypospadias the penis may be more or less completely twisted upon itself. Jacobson [4] has collected a number of cases. In Caddy's [5] case the torsion was unaccompanied by any urethral defect.

Absence of Penis.—The various amputations of the penis, surgical, traumatic, or gangrenous, do not concern us here. The congenital deformity is a rare one, and usually unaccompanied by any faulty development of the testicles or of other parts of the body. The scrotum, however, is usually small and may be bifid. In either case the external genitals closely resemble those of a woman. This is male pseudohermaphroditism. The line of pubic hair is said to be an infallible sign of the sex of such a person if an adult. If a female, the upper

[2] Case I, Van Buren and Keyes.
[3] *J. d'Urol.*, 1912, ii, 392.
[4] *Diseases of the Male Organs of Generation*, 1892, p. 612.
[5] *Lancet*, 1894, ii, 634.

border of the hair forms a transverse line across the hypogastrium, while the hair of the male rises up in a curved line toward the umbilicus.

The urethra opens in the median perineal raphé or on the anterior rectal wall. In the latter case there is danger of ascending infection. Harris[6] collected six cases, including one of his own.

Apparent Absence of Penis.—Congenital dislocation or apparent absence of the penis exists when the penis, lacking its proper sheath of skin, lies buried beneath the integument of the abdomen, thigh, or scrotum. Boutelier reports such a case. Under the skin above the scrotum a movable body is felt, liberated by incision, and discovered to be the penis. Another case, reported by J. Murphy, would seem to be rather a penile adhesion to the hypogastrium, for the child could urinate through a hole in the lower part of the abdomen. The *treatment* of such a condition implies the immediate liberation of the incarcerated member to avoid urinary infiltration. In this emergency any method of covering the denuded penis with skin may be employed, the simpler the better, leaving until later years the task of affording a more satisfactory envelope to the organ.

Congenital incurvation of the penis and scrotal concealment of that organ occur as phenomena accessory to hypospadia.

Hermaphroditism.[7]—Accepting Klebs's definition of true hermaphroditism —viz., the existence of dissimilar genital glands, *i.e.,* at least one testis and one ovary, in one individual—very few such have been proven. In no case has it been recorded that the person was, functionally, both male and female, producing both spermatozoa and ova. On the contrary, as a general rule they are sexually neuter. These true hermaphrodites resemble clinically the pseudohermaphrodites—persons whose sex can with difficulty be determined—and they sometimes come to the surgeon asking him to make them distinctively male or female, whichever he may deem more appropriate. In deciding such a question, if the external genitals are quite indeterminate—as they often are—the chief characteristics to be considered are the shape of skeleton, the disposition of the superficial fat, the growth of hair, facial and pubic (see above), the voice and the shape of the larynx, and, finally, the sexual sentiments of the individual. The process of "making a man of him" or "a woman of her" may be long and tedious, but may prove successful, as in a case reported by Gruber,[8] in which amputation of the hypertrophied clitoris, posterior colpotomy to enlarge the rudimentary vagina, and electric epilation of the facial hair sufficed to establish the external female characteristics.

ACCIDENTS TO THE PENIS AS A WHOLE

Wounds.—The penis is liable to be wounded by accident or by design. In the latter case insanity, or the melancholy depression produced by masturbation,

[6] *Am. Pract. & News,* 1894, xvii, 27.
[7] *Cf.* Hart, *Edinb. M. J.,* 1814, xiii, 295.
[8] *Centralbl. f. d. ges. Therap.,* Wien, 1897, xv, 385.

induces the patient to mutilate himself; or the injury may be inflicted by a jealous woman.

Superficial cuts are unimportant, but wounds extending through the sheaths of the corpora cavernosa may give rise to troublesome, possibly fatal, hemorrhage, while the cicatrices left after healing may distort the penis and render erection imperfect and painful.

Treatment.—Cleanse the wound. Endeavor to obtain primary union by immediate suture. Introduce the sutures just deep enough to hold the fibrous sheath. Erections, which are sure to occur, since the local inflammation induces a flux of blood, retard healing.

Even in cases seemingly desperate, where the penis has been almost wholly severed from the body, an attempt should be made to save it. A remarkable success in a case of this sort, where the whole penis was severed except a portion of one corpus cavernosum, is related by Rochet.[9]

Contusions.—The escape of blood under the skin after superficial contusions of the penis is often excessive, on account of the laxity of the connective tissue and the large size of the superficial veins. Deeper contusions give rise to localized swelling from circumscribed effusion of blood. This swelling fluctuates and deforms the penis more or less, sometimes causing it to deviate when erect. Inflammation of the corpora cavernosa may result, terminating in suppuration or gangrene. Severe contusions involving the urethra may lead to infiltration of urine and urethral fistula.

The introduction of the penis into a ring is a classical accident. The penis swells, the patient is ashamed to seek relief, and serious inflammatory mischief—even gangrene, urinary fistula—may ensue (Fig. 173). Guillot in such a case conceived the happy idea of dissolving the ring, which was of gold, in a bath of mercury.

When the fibrous sheaths of the corpora cavernosa are ruptured by sudden forcible flexion of the erect penis, a sort of fracture of the member is produced, with extensive extravasation of blood, sometimes amounting to traumatic aneurysm.

Subcutaneous hemorrhage may be controlled by the application of cold and pressure, with due regard for the possibility of sloughing if the treatment is overdone. Later, simple pressure to promote absorption will suffice, or the clots may be evacuated through an incision made under local anesthesia with the usual aseptic precautions. If gangrene occur, the penis should be kept absolutely dry and clean by applying a mildly antiseptic powder and a gauze dressing. The gangrenous tissue may be removed piecemeal, after which the gaps may be filled in by skin-grafting or by a plastic operation.

Injuries involving the urethra are described in Chapter XLII.

Treatment.—A catheter is passed into the bladder to insure the patulousness of the urethra. Upon this the penis is bandaged and an ice-cap applied. If the pressure proves unbearable or if gangrene, extravasation, or cellulitis

[9] *Bull. Soc. de Chir.*, vii, p. 451.

threaten, the clots must be evacuated and the bleeding checked by suture. The urine must then be diverted through a hypogastric opening.

After recovery an indurated spot may remain permanently to mark the site of the injury, perhaps resulting in priapism or stricture.

Fracture of Corpus Spongiosum.—Fracture of the corpus spongiosum is generally occasioned by "breaking the chordee" in gonorrhea. The inflamed

FIG. 173.—GANGRENE OF PENIS ENCIRCLED BY A RING.

tissue gives way, yielding urethral hemorrhage with traumatic stricture as a remote result.

The healthy corpus spongiosum may be fractured during erection. Dittel [10] gives one such case. My father has seen another.[11]

Dislocation of the Penis.—When the integument of the penis is violently dragged upon, as, for instance, when the clothes are caught and torn away upon a revolving wheel, the entire penis may be shot out of its investing cutaneous sheath and lodged in the scrotum, the perineum, the groin, or under the integument of the abdomen. In such cases, the semimucous membrane of the prepuce gives way either at the preputial orifice or just behind the corona. A number of instances of this curious luxation have been recorded.[12] The penile injury is usually not discovered until retention of urine or the passage of urine by some opening at a distance from the preputial orifice directs attention to the contused genitals, when the penis is found to be only a sheath of

[10] *Wien. med. Bl.*, 1885, Nr. 2.
[11] Van Buren and Keyes, 1st ed., p. 7.
[12] *Cf.* Goldsmith, *Lancet*, 1898, ii, 387.

integument containing clotted blood. Sometimes it has been difficult to find the penis at all; but an intelligent search will always reveal it, and then the surgeon's obvious duty is to replace it in its sheath, incising the integument about its root as far as may be necessary to attain the desired result. The urethra is often ruptured as well and, after the organ has been replaced in its sheath, operation for urethral rupture may be called for.

CUTANEOUS AND MUCOCUTANEOUS AFFECTIONS OF THE PENIS

Many common skin diseases involve the skin of the penis as well as other integumentary parts. As a rule, they present no special characteristics and require no comment here. *Venereal sores,* true chancre and chancroid, are common, as also are soft venereal warts. These receive mention elsewhere. Hutchinson [13] circumcised a boy for *lupus* of the prepuce and obtained a perfect result. Rake, of Trinidad,[14] has performed circumcision on sixteen *lepers,* and, even though the incision actually traversed a leprous patch, it always healed kindly.

Scabies.—Scabies produces papular, crusted and confluent lesions on the glans or skin of the penis, closely resembling the venereal papules or sores. The lesion is crusted rather than ulcerative, typical burrows may be found elsewhere, and the effect of sulphur ointment is magical.

Herpes Progenitalis.—When occurring on the cuticular layer, herpes runs its course as it does elsewhere on the body, but when vesicles develop within the preputial orifice the epithelium of the vesicles is soaked off, little ulcerations result, and balanitis, with vegetations, and inflammatory phimosis, may be the ultimate result. Exceptionally the ulcerations become deep and angry, and the diagnosis from chancroid difficult, while the glands in the groin may inflame and suppurate.

The affection shows a marked tendency to recur. A tight prepuce and contact of irritating discharges act as predisposing causes.

Diagnosis.—Vesicles, usually in groups, always precede the ulcerations, while the latter are irregular in shape, superficial, and very rarely complicated by suppurating bubo. The pus is not auto-inoculable. Under treatment the ulcers heal in a week.

Treatment.—Until the vesicles break there is no treatment. Thereafter the ulcers should be dusted with any mild antiseptic powder. Recurrence may sometimes be prevented by circumcision; but often it cannot be prevented.

Herpes Zoster.—Zoster may occur upon the penis as elsewhere.

Lichen Planus.—This occurs on the glans penis, simulating almost precisely a squamous syphilid. They may be distinguished by the Wassermann reaction and by biopsy. Elliott states that the syphilitic eruption is never wholly confined to the penis but always appears simultaneously on other parts of the body.

[13] *Arch. Surg.,* 1890, ii. 17.

[14] *St. Louis M. & J.,* 1893, lxiv, 221.

Balanoposthitis.—Balanitis is an inflammation of the surface of the glans penis. Posthitis is an inflammation affecting the mucous surface of the prepuce chiefly. Neither can exist for any length of time without becoming more or less complicated by the other. For practical purposes they must be considered together.

Etiology.—A long or tight prepuce is a predisposing cause. The exciting causes are mechanical irritation or uncleanliness from retention of smegma, or from contact with diabetic urine, gonorrheal, leukorrheal, menstrual, or other infected fluids.

Symptoms.—The membrane at first becomes reddened, then mottled and moist; next the epithelium comes off in patches, leaving irregular excoriations which soon ulcerate and discharge a purulent fluid. The ulcerations are not preceded by vesicles. There is a burning soreness with itching at the end of the penis, usually scalding on urination. The entire prepuce may inflame, become red and infiltrated, producing inflammatory phimosis. The ulcerations rarely become deep, and the inguinal glands do not often suppurate, but they may grow somewhat large and tender. In chronic balanitis with phimosis, the mucous surface of the prepuce is granular and even condylomatous.

Erosive and gangrenous balanitis[15] is a specific infection caused by a spirochete and a bacillus quite similar to those found in Vincent's angina. Corbus believes the infection to be derived directly or indirectly from the mouth. The infection, if mild, results in superficial erosions about the corona or the adjacent portions of the prepuce, rarely on the glans penis. This infection may lead to ulceration, cellulitis of the prepuce, and even to gangrenous ulceration with perforation of the prepuce.

Erosive meatitis of little boys is a circumscribed lesion about the meatus described by Goldenberg.[16] It lasts a few months and heals spontaneously. The scab may close the meatus. Any mild ointment will prevent this.

Adhesions due to balanitis are uncommon after early childhood. In elderly persons the possibility of *epitheliomatous degeneration* in a patch of chronic balanitis must be borne in mind.

Diagnosis.—Balanitis occurs only under a long or a tight prepuce. Simple balanitis must be distinguished by urinalysis from diabetic balanitis.

Ulcerative balanitis cannot be distinguished from inflamed herpes in many cases.

Treatment.—If the prepuce can be easily retracted without causing paraphimosis, simple balanitis may be speedily relieved. Cleanliness is of the first importance, but soap should not be used. Warm water will remove all the discharges. After washing, the parts should be dried by gently touching them with a soft cloth, and dusted, by the aid of a dry camel's-hair brush from which the powder may be evenly shaken, with bismuth and calomel, or any fine powder. A piece of old linen, just large enough to cover the glans, and with a hole cut

[15] *Cf.* Corbus and Harris, *J. Am. M. Ass.*, 1909, lii, 1474.
[16] *Am. J. Surg.*, 1910, xxiv, 218.

in its center so that it may be slipped like a collar around the corona, is now to be moistened in a mild antiseptic solution, acetate of aluminum 2 per cent, or aromatic wine and water, equal parts, and laid over the glans, leaving the meatus uncovered. The prepuce is then pulled forward to its natural position. In this way friction between the inflamed surfaces is avoided, all the discharges are absorbed, and a mildly stimulating fluid is kept in constant contact with the ulcerated or abraded surfaces. The dressing should be repeated two to four times daily, according to the discharge. After recovery a dry piece of gauze should be kept between the glans and the prepuce for some weeks, renewed twice daily. Argyrol, 50 per cent, is an almost infallible application. It should be employed in all severe cases.

If the prepuce cannot be retracted, it should be incised, as for chancroid, and sores and wounds bathed lavishly in 20 per cent argyrol solution.

If chancroid be present, inoculation of the wound is inevitable. Yet chancroidal cases require operation most urgently in order to expose the sore, whose ravages, perhaps upon the glans penis, are progressing uncontrolled. A large chancroid exposed is better than a small one concealed.

Circumcision.—In chronic and inveterate cases, or where insignificant causes produce constant relapse, circumcision affords a certain cure. Circumcision of diabetics, while almost certain to prove curative, may result in gangrene.

ACUTE INFLAMMATORY AFFECTIONS OF THE PENIS

Cellulitis.—Cellulitis arises from chancroids, balanoposthitis, trauma, or gonorrheal periurethritis. The inflammation may spread to the abdomen, scrotum, or thighs, or it may involve the erectile bodies.

Lymphangitis.—Lymphangitis is comparatively benign. A lymphangitis of the large dorsal lymphatic may be differentiated from phlebitis of the dorsal vein by the fact that the cord of induration extends outward, at the root of the penis, toward a group of enlarged glands, instead of disappearing beneath the symphysis pubis.

Erysipelas and Gangrene.—The two are one, the gangrene fulminating. The first lesion is a small red, inflamed spot, usually on the prepuce and mistaken by the patient for a pimple. But within a few hours there is a chill followed by high fever, as a red flush rapidly extends over penis and scrotum. Within twelve to twenty-four hours the intensity of the swelling has strangulated the subcutaneous tissue, which becomes gangrenous. The gangrene rapidly invades the skin. I have seen the whole penis and scrotum gangrenous within a day of the time the patient first noticed anything wrong.

The streptococci are found in the tissues. The lesion resembles periurethral gangrene. One does not stop to distinguish between them.

With the patient under spinal anesthesia and in the lithotomy position the whole area of gangrenous skin is rapidly excised and the stinking black mass beneath rapidly cut away, at least sufficiently to explore its every crevice with

the utmost care, to be sure that no burrowing infection has been overlooked. All overhanging skin is then split—no multiple incisions—so as to leave a wide open wound, which is packed with vaseline gauze.

As soon as the slough has separated the elasticity of the scar pulls the remains of the loose scrotal skin over the exposed testicles with amazing rapidity. No plastic repair is required for the scrotum, though the healing of the penis may be expedited by skin-grafting (Figs. 149, 150).

Cavernitis and Penitis.—Inflammation of the corpora cavernosa or of all three erectile bodies arises from cellulitis or its causes, especially inflammation in the bulb of the corpus spongiosum.

The course of the disease is that of an acute inflammation with constant priapism and edema added to the usual local symptoms. While the inflammation may be walled in by occlusion of the vascular spaces, pyemia is "a terribly frequent complication" (Jacobson).

Treatment.—The treatment should therefore be most energetic. Indurations in the erectile bodies should be freely incised, packed to check the hemorrhage, and later irrigated frequently.

TUBERCULOSIS

Tuberculosis of the penis is a rare lesion. I have seen but three or four cases in the last ten years at Bellevue Hospital, though the class of patients seen there is precisely that among whom the lesion should be most common. It begins primarily in the skin of the penis or extends to the surface from the urethra. Tuberculosis following ritual circumcision is extremely rare now that the custom of sucking the wound has been given up.

If an extension from the urethra, the lesion first appears about the meatus. Ritual tuberculosis begins in the cut edges of the prepuce. Otherwise the lesion usually begins about the glans penis or prepuce. The lesions I have seen were irregular ulcers, very chronic, indurated, with hard base and everted edges, rather less sloughy than a gumma, but closely resembling a carcinomatous ulceration, except for the fact that spontaneous cicatrization occurs in spots.

The lesion extends very slowly and irregularly over the skin, not involving the deeper structures, usually taking several years to involve an inch or so. In so doing it usually heals in one spot as it extends to another.

The lesion should be treated like tuberculosis elsewhere. It yields slowly to the x-ray or Finsen light and recovery has been reported following thorough cauterization with the actual cautery.

GRANULOMA INGUINALE

This condition had been believed to be exclusively a tropical disease until the report of Symmers [17] of cases found in Bellevue Hospital. Since then many

[17] *J. Am. M. Ass.*, May 8, 1920, p. 1304; also Campbell, *J. Am. M. Ass.*, Mar. 5, 1921, p. 648; also Randall, *Surg., Gynec. & Obst.*, 1922, xxxiv, 717.

others have reported cases of the disease which could not be traced to a tropical infection. It is southern endemic in the United States. It occurs almost exclusively among negroes, affecting both sexes. The method of infection is not known though it is believed that the Donovan organisms, found in mononuclear cells, are the exciting cause. Randall claims to have cultivated these organisms. The organisms appear as small rounded bodies which, under Wright's stain, are pink with a blue coccoid central body or oval with a bacillary or diplococcoid dark blue central body. The outer zone has a capsule; the central bodies are metachromatic granules.

Fig. 174.—Granuloma Inguinale.

The patient is a negro; the lesions are on glans penis and groin.

The lesion itself appears first on the genitals or in the groin. It begins as a papule, relatively insensitive, which ruptures, exudes a watery pus, refuses to heal and slowly spreads. The gross character of the ulcer is quite different from any other genital ulceration. Its base is gelatinous, looks reddish, exuberant, overgrown, soft, so that in making cultures the loop can be pushed deeply into this tissue. The edges are quite the opposite to those seen in chancroid; instead of being undermined they turn out and overlap the healthy skin. The lesion may heal in some spots and spread in others, secondary foci spring up and all sorts of cicatricial and ulcerating distortion of the parts result. The lesion is destructive and also causes lymph block.

Symptoms are few; pain, slight discharge, unimportant in comparison to the size of the lesion; the patient ultimately dies from secondary anemia and the infection from the large lesion. The diagnosis is readily made if the condition is but thought of as a possible cause of any chronic genital ulcer.[18] Koppel recommends that doubtful cases be diagnosed by intracutaneous injection of sterile pus obtained from buboes (Frei test). The Donovan bodies are usually found quite readily.

The condition can be cured by intravenous injection of tartar emetic 0.1 gram in 10 c.c. of sterile normal saline solution sterilized in the autoclave (remembering that it cannot be boiled). Ampules of the solution are to be had. Injections are given daily beginning with the dose 0.04 gram and increasing

[18] *Klin. Wchnschr.*, Dec. 24, 1927.

to 0.1 gram. As the higher doses are reached the patient may have chills and joint pains in which case the interval between injections is lengthened. About twenty injections are needed to effect a cure and apparent cures must be followed closely for several months in order that relapses may not be overlooked. Cauterization or excision makes it worse.

Women suffer from this infection much more severely than men. The lesion usually begins in the fourchet and eats away vagina, perineum and urethra. Matis, of New Orleans, combines antisyphilitic treatment with the tartar emetic injections for cases that do not yield to the latter and cuts away the indurated tissues as they heal, in order to open up deep hidden foci.

CHAPTER LXVI

PHIMOSIS; PARAPHIMOSIS; TUMORS OF THE PENIS

Preputial Deformities.—Practically, the deformities of the foreskin, phimosis and atresia of the orifice excepted, are unimportant. The prepuce is sometimes bifid, enlarged into a pouch, redundant, or rudimentary. When the prepuce is deficient, the epithelium of the uncovered glans penis becomes hard and tough, more nearly resembling ordinary cuticle. Under these circumstances its sensibility is diminished, but it is less liable to become excoriated or inflamed. Hence, absence of the prepuce is not to be regretted, and the operation for its restoration (posthioplasty) need not be described.

PHIMOSIS

Phimosis exists where the orifice of the prepuce is so small that the glans penis cannot be uncovered. The orifice of the prepuce may be congenitally closed (atresia preputii). Phimosis is congenital or acquired, simple or inflammatory, or complicated by other diseases or by adhesions.

In young children preputial redundancy is so common that it may be considered normal. The foreskin of an infant is developed out of all proportion to the rest of the penis, taking the member after puberty as a standard for comparison. Whenever the prepuce can be fully retracted there need be no anxiety about the future; the preputial orifice will enlarge sufficiently before or at puberty.

Phimosis may be brought about secondarily through induration and inelasticity of the skin caused by frequent attacks of preputial inflammation. The meshes of the connective tissue, at first distended with serum, become secondarily thickened and hypertrophied, leaving a thick, indurated, inelastic prepuce that cannot be retracted. This condition, as described, is known as inflammatory phimosis.

Another common cause of acquired phimosis is the cicatrization of multiple chancroids around the orifice of the prepuce. Diabetic eczema produces phimosis. Demarquay quotes a case where a passionate and jealous woman made her lover wear a gold padlock with which she secured the preputial orifice, keeping the key herself. The victim of her charms carried his padlock, which was replaced from time to time through new punctures, during four or five years, until such a degree of irritation had been set up that Petroz and Dupuytren, when consulted, diagnosticated cancer, and removed the prepuce. No relapse of the cancer is recorded.

Treatment.—Circumcision in infancy will leave the patient less subject to venereal disease and to sexual irritability in later years and guarantee him against epithelioma of the penis. The operation has of late years attained great popularity. I favor it for all infants whose foreskins are long or tight.

A positive indication for operation upon a child does exist, however, when the preputial orifice is smaller than that of the urethra. This condition is evinced by ballooning of the prepuce during micturition, for the urine flows into the cavity more rapidly than it can escape from the orifice. The retention of a drop or two of urine in the cavity of the prepuce after each act of urination leads to balanitis, suppuration, the growth of vegetations, formation of the preputial stone, or incrustation of the glans. Also circumcision is helpful for the retention of an indwelling catheter.

When the adult prepuce is tight, an operation may be called for, even though phimosis, strictly speaking, does not exist. For example, the collection of smegma, or repeated attacks of herpes, may necessitate operation. Again, if an individual with a tight prepuce gets chancre, chancroid, or gonorrhea, serious inflammatory complications are likely to arise.

PARAPHIMOSIS

Paraphimosis exists when the prepuce is retracted behind the corona glandis and cannot be replaced.

Causes.—An unnaturally tight preputial orifice is a predisposing cause of paraphimosis.

Inflammatory paraphimosis may depend upon balanitis, gonorrhea, herpes, chancroid, chancre, etc.

Symptoms.—The glans penis is swollen and livid. Behind the corona, most marked below, rises a tense, shining, edematous belt of the mucous layer of the prepuce. Behind this there is a deep sulcus or furrow, most marked above, often the seat of superficial ulceration. Here lies the stricture; behind it there rises another edematous fold, usually smaller than the one in front (Fig. 174).

If the stricture of the prepuce is tight enough to arrest the circulation, it may finally cause the destruction by gangrene of all tissues lying in front of it.

Treatment.—Reduction may almost invariably be accomplished without incision, if the following details are observed, viz.:

1. The stricture must first be pulled well back. Exceptionally the mucous membrane is unfolded at the dorsum; this must be smoothed out by still further retracting the prepuce.

2. The edema must be thoroughly squeezed from in front of the stricture to the shaft of the penis behind it. Until one has patiently squeezed such a penis for several minutes, it is quite incredible how fully the edema may thus be reduced and shifted to the shaft of the penis (Fig. 175).

3. Reduction is then accomplished by forcing the stricture slowly over the

head of the penis—so slowly as to squeeze out the remaining edema. It is futile to attempt to pry the stricture over the glans until the edema has been reduced.

The following is the best method of reduction: Seize the penis behind the strictured prepuce in the fork of the index and middle fingers of both hands, one placed on each side. Now make pressure with the thumbs on both sides, in such a direction as to compress the glans laterally, rather than from before backward, and at the same time pull the strictured portion of the prepuce forward, the effort being rather to pull the stricture over the glans than to push the glans through the stricture.

If a prolonged, careful attempt at reduction fails, the strictured point must be divided. This may be done under local anesthesia.

After reduction, the treatment consists in elevation of the penis within a jock-strap, and syringing the preputial cavity with a mild antiseptic solution. When the edema has subsided circumcision should be performed.

Gumma.—Gumma occurs often in the glans or the prepuce, very rarely in the urethra and the corpora cavernosa. The so-called relapsing chancre is a gummatous deposit in the scar of the initial lesion. The history, the influence of treatment, and, if necessary, the examination of a section of the growth determine the diagnosis. In the corpora cavernosa gumma resembles circumscribed fibrosis, but is deeper, less cartilaginous, and almost always occurs in the posterior third of the organ (Zeissl). I have never seen a gumma of the corpora.

TUMORS OF THE PENIS

Cysts.—Implantation, and sebaceous cysts occur. The last originate in the sebaceous glands of the skin or prepuce. Cysts occur almost always in the prepuce and are readily enucleated.

Benign Neoplasms.—Lipoma, adenoma,[1] and angioma have been described. They are rare, and their removal is a question of judgment involving a recognition of the function of the penis as an intromittent organ, and the possible loss of this function from the formation of a cicatrix.

Papilloma.—More important because of their frequency are the papillomata (*condylomata acuminata*) of the penis. They are commonly denominated *venereal warts*. This title, however, is not exact, since there is no necessary connection between them and any venereal disease. They are papillary overgrowths, often highly vascular, and composed of epithelium. They may be prominent and pedunculated, or flat, and growing from a considerable surface. They are nearly always multiple. They are caused by inflammation, or by lack of cleanliness. Consequently the most favorable condition for their production exists in gonorrhea, in balanitis, or when mucous patches occupy the cavity of the prepuce. Their favorite seat is just behind the corona glandis, but they are also encountered anywhere within the cavity of the prepuce, at its orifice, upon its cutaneous surface, or even within the urethra. They are found also upon the scrotum, and

[1] *Morrow's System*, 1893, i, 58.

FIG. 175.—PARAPHIMOSIS.

FIG. 176.—PARAPHIMOSIS.
The edema is squeezed out preparatory to reduction.

frequently around the anus. They are, when numerous, bathed in a fetid, puriform secretion, and may grow large enough within the prepuce to cause phimosis. They occur upon young children, and are found in their greatest luxuriance within and around the vulvæ of women affected with irritating discharges—discharges not necessarily venereal in any sense.

Implantation warts also occur after circumcision.

Warts should be differentiated from mucous patches and condylomata lata by the typical flat appearance of the syphilitic lesions and the Wassermann reaction.

From commencing epithelioma the diagnosis may be extremely difficult. When in doubt examine a snipping under the microscope, and if it appears benign, treat it as such, but remove it in any case. If it recur, and the patient is over fifty, it is safest to exsect it as though it were epitheliomatous, whatever the findings of the pathologist. Radium is very efficient for this class of cases.

Unless kept scrupulously clean, warts sometimes ulcerate, and they may even suppurate, light up suppurating buboes, and even cause gangrene of the penis. Simple cleanliness and dryness often causes them to atrophy.

Epitheliomatous degeneration may take place, and is always to be feared. Implantation warts are especially liable to hypertrophy and become horns.

Repeated washing with soap and water followed by the application of calomel often causes vegetations to shrink up and disappear. In case vegetations are complicated by balanitis, treatment of the latter will often at the same time triumph over the warts. But circumcision is usually required.

The warts that do not shrink under this treatment should be destroyed by the high frequency current after anesthetization with novocain or cocain crystals.

If there is any suspicion of epithelioma a biopsy should be done.

Horns.—Horny growths may spring from the glans or the integument. They begin as warts and are very prone to epitheliomatous change. Brinton[2] has described a curious case and collected others from the literature.

Benign Tumors of the Erectile Bodies

The benign tumors of the erectile bodies of the penis are four: *circumscribed fibrosis, enchondroma, osteoma,* and *calcification.* The first is comparatively rare, the others extremely so.

Circumscribed Fibrosis.[3]—The malady is gouty in origin, comparable to Dupuytren's contraction of the palmar fascia. It usually appears between the ages of thirty-five and fifty.

The growth occurs in the sheath of the erectile body. It is a fibrosis which may show patches of enchondroma.

The affection comes on insidiously, without apparent cause, although the

[2] *Med. News,* 1887, li, 141.

[3] Kretschmer; *J. Urol.,* 1926, xvi, 497 (and discussion on p. 553).

patient sometimes ascribes it to injury. The first symptom is a bending or a slight pain at a certain point in the penis when the organ is erect. Examination detects a hard, flattened mass with sharply defined margins, occupying one or both corpora cavernosa near the surface, and feeling like cartilage—elastic, springy, not as bony as a calcareous plate. The corpus spongiosum does not participate in the disease. The penis bends during erection at the affected point, and along the edge of the hardness a little pain is experienced. This indurated mass, which is usually irregularly oval in shape, may remain stationary for an indefinite period; or it may progress slowly backward or forward, sometimes retaining its size and shape, sometimes growing larger, sometimes smaller.

A slight tenderness is perhaps felt along the line of advancing induration, and moderate uneasiness is usually produced by pressing the induration between the fingers or by erection. The usual site is the septum and adjacent portions of the sheath on the dorsum of the penis, not far from the glans.

The prognosis is negatively good in that the fibrous mass never ulcerates or becomes cancerous, may get spontaneously better, even possibly well, or may, and sometimes does, develop backward until it gets so low down toward the root of the penis that it no longer seriously interferes with upright erection. I have seen more than one patient who, at one time being debarred from sexual intercourse, has by a shifting of the position of the induration again become potent. I have met one person with a distinct plaque of some size, of which he had no knowledge whatever. The distinction between fibroma and enchondroma can only be made pathologically. Ossification is extremely rare.

An effective treatment of this sigular malady is yet to be discovered. Thus far time only has seemed to help it.

Thiosinamin, antisclerosin injections, blisters, oleate of mercury, tincture of iodin, the iodids, and electrolysis, have uniformly failed. Excision only replaces the fibrosis by scar tissue. Piperazin is well spoken of. X-rays and radium are useless.

Calcification and Ossification.—Both of these conditions are usually, probably always, secondary to fibrosis, or enchondrosis of the erectile bodies. Calcification of small patches is quite rare, ossification is even more unusual. Cases of this latter condition have been reported by von Lenhossek,[4] Demarquay,[5] Porter,[6] Jacobson,[7] and Chetwood.[8] In Chetwood's specimen certain spots were simply fibrous, others were cartilaginous, while the bulk of the growth was true bone. To compare penile osteoma with the bony development normal in the penes of certain monkeys is scarcely logical.

Calcification or ossification may cease after more or less of each corpus cavernosum has suffered, or it may involve the whole organ pretty generally.

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[4] *Virchow's Arch.*, 1874, lx, i.
[5] *Op. cit.*, p. 354.
[6] *N. York M. Rec.*, 1882, 270.
[7] *Op. cit.*, p. 683.
[8] *J. Cutan. & Genito-Urin. Dis.*, 1899, **xvii, 231.**

Sexual intercourse may be seriously interfered with, if not prevented altogether.

Treatment.—Medicine holds out no hope to the sufferer. If the disease has come to a standstill and the deposit is superficial and small, it may be removed with the knife—an operation which has been performed with success by Regnoli, MacClellan, and Huitfeldt.[9]

Malignant Neoplasms of the Penis

The primary malignant new growths of the penis are *sarcoma* and *epithelioma.* The former is very rare. It arises from the erectile bodies, usually the corpora cavernosa. The latter, much more common, begins on the glans or on the prepuce. Epithelioma of the urethra is considered with the other diseases of that canal.

Secondary new growths present no peculiar features. They either form part of a disseminated carcinosis or are mere extensions of the tumor from an adjoining region, usually the scrotum.

Sarcoma.—Sarcoma is very rare. With or without previous trauma a tumor appears in one of the erectile bodies. The fact that it is a distinct lump and not a flat indurated patch readily distinguishes it from the benign tumors of these structures. Moreover, sarcoma usually appears in early manhood and develops with characteristic rapidity and early involvement of the inguinal glands. Exceptionally, however, it grows slowly and the glandular involvement occurs late. Joelson[10] collected thirty-six cases, nine of them being endotheliomata. Eight were melanotic. Three-fourths of them appeared after the thirty-fifth year; most of the patients were over fifty. As the tumor grows it causes priapism by occluding the cavernous spaces, and may also occlude the urethra and so cause retention of urine. Radiation therapy followed by amputation of the penis is the treatment. The prognosis is absolutely bad.

Epithelioma.—Epithelioma of the penis (Figs. 177, 178) begins on the prepuce or glans, both of which are usually involved when the patient presents himself for examination.

Though Freyer has reported a case in a youth of seventeen and Kaufmann places 6 per cent of the cases in the third decade, epithelioma is usually a disease of later life. One case developed in the scar of a horsebite, others have arisen from the scars left by venereal sores, a few from urethral fistula; but warts and chronic balanitis are the most fruitful sources of epithelioma, the former especially if neglected and allowed to remain foul and moist. Finally, *phimosis is the real predisposing cause of epithelioma.* By retention of the smegma and urine it predisposes the patient to balanitis, vegetations, and fissures of the foreskin, and these processes once set up are kept concealed and constantly bathed in an acrid and irritating fluid. Dean states that none of his patients

[9] *Norsk Mag. f. Lægevidensk,* 1910, lxxi, No. 1.
[10] *Surg., Gynec. & Obst.,* 1924, xxxviii, 150.

was circumcised in youth. I have seen one epithelioma of the prepuce without phimosis.

Symptoms and Course.—In about five out of six cases the disease begins as a wart situated on the glans or on the inner surface of the prepuce. This wart is intractable to ordinary methods of treatment, and recurs if cut or burned away. As it grows it assumes a lobulated, cauliflower appearance, and soon begins to ulcerate in places, and to exude the characteristic foul ichorous dis-

Fig. 177.—Epithelioma of Penis.

The growth has ulcerated through the unretracted prepuce.

charge. Then the base gradually takes on the hard induration of the epitheliomatous ulcer with everted edges. The inguinal glands are involved late. The lymphatics of the penis so anastomose that a so-called crossed bubo—the sore on the one side of the penis and the bubo in the opposite groin—occurs not infrequently.

More rarely epithelioma begins as a raw spot or an indolent ulcer, and still more rarely it appears first as a subcutaneous nodule or as a patch of leukoplakia.

Locally, the growth may spread over quite a large superficial area without involving the corpora cavernosa, but when these become invaded secondary

growths develop to their very depths. Involvement of the corpus spongiosum results in stricture.

Diagnosis.—The diseases which may be confused with epithelioma of the penis are warts, chancre, chancroid, granuloma, tuberculous ulcers, and ulcers from chronic balanoposthitis. The diagnosis is made by biopsy.

As we have seen, the appearance of epithelioma is characteristic enough after its base has become indurated and the infection has begun to spread to the inguinal glands; but it is of the greatest importance that the diagnosis be made before that time, while the disease is yet eminently curable. To this end

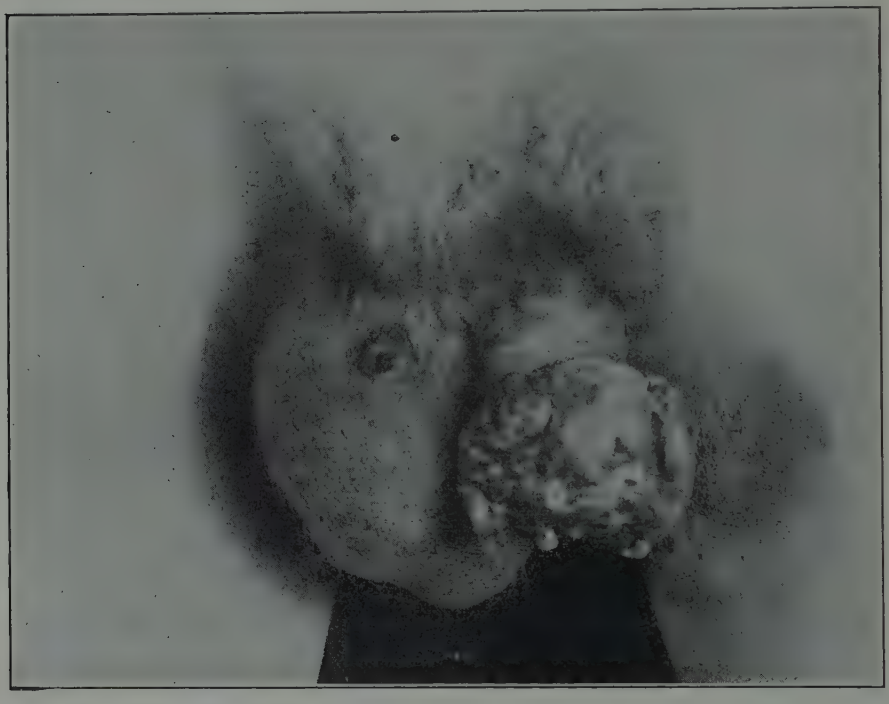

FIG. 178.—EPITHELIOMA OF PENIS. SECONDARY ULCER ON SCROTUM.

all growths or ulcers that prove intractable should be regarded with suspicion, and if that suspicion is confirmed by microscopical examination of a snipping from the diseased tissue, immediate radiation should be insisted upon.

Before the inguinal glands become involved the operative prognosis is good. Afterwards it is bad.

Pathology.—"There are two clinical varieties of epithelioma of the penis, the papillary and the flat. Histologically each lesion is a squamous carcinoma. Each type spreads by progressive involvement of contiguous structures, while at the same time it penetrates more deeply. Metastases occur by embolism. Lymphatic permeation is a later stage in which cancer emboli, caught somewhere in the lymph channel, grow in the directions of lesser resistance" (Dean).

Metastases occur late, usually in the groin glands. Buck's fascia covering the ends of the corpora cavernosa protects these long after the skin over them has become involved.

Symptoms.—"The first symptom noticed by 73 per cent of the patients was a small sore on the penis. The most common site for the primary lesion to appear was somewhere on the glans: 9 per cent were aware of irritation followed by a small sore, 5 per cent suffered from paraphimosis, circumcision revealing a carcinoma, while 5 per cent first saw warts beneath a tight prepuce. The patients with leukoplakia noticed 'scaly skin' which in one case appeared as a 'corn'" (Dean). The lesion grows as a papillary cancer or as a cancerous ulcer.

Treatment.—The treatment employed at the Memorial Hospital to-day depends upon the size of the primary tumor, the depth of its penetration and the presence or absence of metastases. In order to appreciate the size of the tumor, the prepuce may have to be slit. This is also helpful to permit cleaning of the preputial cavity and reacts beneficially upon the mixed infection of the inguinal gland.

"If the primary lesion is 2 cm. or less in diameter, superficial, and no metastases can be detected, we employ irradiation alone. The primary tumor is treated with a placque,[11] the dose being 1200 millicurie hours at 1 cm. distance filtered through ½ mm. of silver and 1 mm. of brass" (Dean).

If the carcinoma, though small, is deeply ulcerating into the tissues, the irradiation is followed by an amputation 2 cm. from the edge of the growth.

Larger tumors are treated, some by irradiation alone, some by amputation alone, but most of them by the two combined. All cases receive a routine high voltage x-ray treatment of 320 ma. minutes with a focal distance of 50 cm., an energy of 200 kilovolts and a filtration of 0.5 mm. of copper and 1 mm. of aluminum. Groins showing known metastases in the form of hard uninflamed glands are given this same x-ray treatment and also a radium pack exposure of 9,000 mc. hours at 6 cm. distance, filtrated through ½ mm. of silver and 1 mm. of brass. Three weeks later the glands may be removed surgically.

Dean reports the following results:

(1) Superficial lesions less than 2 cm. in diameter with no metastases, thirteen cases, with no cancer death; (2) extensive or deep lesions without metastases, thirty-five cases, with twenty-three living, five dead, seven lost; (3) postoperative irradiation upon patients without metastases, two cases, with no deaths; cases with metastases, twenty-five with three alive and well; total, seventy-five cases. The forty-six without metastases show excellent results: thirty-five are living, seven lost, six dead; nineteen of the survivals have passed three years without evidence of disease and ten have passed five years. Of the twenty-five with metastases, two of the three who have survived are alive and apparently well, respectively, two and eight years after treatment.

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[11] The placque is a small box which contains radium emanation in silver tubes. The side of the box which overlies the tumor is made of brass, 1 mm. in thickness.

CHAPTER LXVII

CHANCROID; SUPPURATING BUBO

CHANCROID

Chancroid, or soft chancre, and hard chancre are no more akin than measles and leprosy; and it is unfortunate that the ancient confusion of the local and the general infection has left us this legacy of misleading terms; but it is now too late to change them.

Chancroid is a specific, local, contagious, auto-infectious venereal ulcer.

It is specific in that it is caused by a specific microörganism, the streptobacillus of Ducrey.[1]

This bacillus is dumb-bell shaped, thick and rounded or square at the ends, constricted in the middle. It varies in length from 1.5 to 2 μ. It groups in parallel chains, and occurs both inside and outside the cells. It stains readily with the ordinary dyes, nethylene-blue, or violet, or fuchsin, and is decolorized by the Gram stain.

Chancroid is peculiarly liable to mixed infection. A smear taken from the surface of the ulcer usually shows numerous pyogenic and other bacteria, and few if any of the pathogenic bacilli. Hence such a smear cannot be depended upon for diagnosis.

Chancroid is a local lesion, causing no systemic infection or reaction. It is, therefore, indefinitely auto-inoculable. Indeed, the marked tendency to auto-inoculation is one of the most striking clinical characteristics of the ulcer. That it confers no immunity whatever was amply proven by the disciples of syphilization. Lindemann, for example, inoculated himself 2,700 times with chancroidal pus in the vain hope of immunizing himself against syphilis. But a local and temporary immunity does exist; for after many inoculations a given region becomes temporarily immune, though the virus will still take on other parts of the body.

Clinically, however, such immunity has no significance.

Finally, chancroid is a contagious venereal ulcer. Not once in a hundred cases does one see a chancroid except about the genitals. This is as much as to say that it is practically always acquired by sexual contact. Although many cases of mediate contagion have been reported, the virus being usually conveyed by the hand, such cases are proportionately extremely rare. Indeed, chancroid will not "take" upon the integument unless it is abraded. Cullerier's experiments show that this must oftentimes be true of the vagina as well. In two

[1] *Riforma med.*, 1889, v, 98.

cases he deposited pus from a chancroidal bubo in a clean vagina, and let it remain there between half an hour and an hour. Then some of the vaginal secretion was collected and inoculated upon the thigh, after which the vagina was thoroughly cleansed. In both instances typical chancroids developed on the thigh while the vagina remained clean.

Hence, be it noted, a woman may convey chancroid from one man to another without herself becoming infected.

Yet auto-inoculation of chancroid upon the healthy skin or mucous membrane lying in contact with it is extremely common. But it takes many hours of intimate contact to effect the inoculation.

In the clinic chancroids are common, in private practice rare. The reason for this is twofold. In the first place, chancroid can never make headway among cleanly persons, for it is so foul and disgusting that no decent citizen infected with it would attempt sexual intercourse until it is cured, and half a cure—such as so commonly conceals the infectiousness of syphilis and gonorrhea—is here impossible. In the second place, in most instances, a little soap and water at the time of exposure may be depended upon as a safeguard against it.

Chancroid flourishes only where soap and water are not esteemed.

Chancroids upon the male genitals are most common in the coronary sulcus, especially in the little pocket on each side of the frenum. Urethral chancroid is extremely rare.

In women the sores usually occur about the introitus, rarely higher up.

From these regions the ulcers may spread by contact or by direct extension over external genitals, anus, thighs, abdomen, and even farther afield.

Chancroid commonly begins as a single ulcer; but no sooner has this appeared than secondary ulcerations begin, so that by the time the physician is consulted several sores are usually present.

Symptoms and Course

The disease has an incubation period varying from one to ten days, usually three to five. A protracted incubation is probably due to the fact that the virus is retained some days within the prepuce, or vagina, before inoculation occurs.

The symptoms of chancroid are best observed by studying the course of the artificial ulcer produced by inoculation. Within twenty-four hours after such an inoculation a reddish blush surrounds the puncture. This soon changes to an inflamed areola which, in the third day, rarely sooner or later, becomes a pustule. This extends quite rapidly, and within a few days breaks and becomes a characteristic chancroidal ulcer.

The typical chancroid is a round ulcer with undermined or perpendicular edge. The ulcer is usually rather deep. Its base is irregular, grayish yellow, and covered by a pultaceous false membrane. It is surrounded by a non

indurated, inflammatory areola. The secretion is abundant and purulent. It bleeds readily. It may be intensely painful.

If untreated and uncomplicated the ulcer increases in size for a week or two. Then, having attained a diameter of about 1 cm., it remains stationary for about two weeks, and then (unless under the prepuce) gradually heals by cicatrization from the edges toward the center. So rarely, however, is the ulcer both uncomplicated and untreated that the stage of spontaneous healing is not seen in the clinic.

Complications

The common complications of chancroid are mixed infection with syphilis—mixed sore; mixed infection with pyogenic microbes—inflamed chancroid; destruction of the frenum, phimosis, gangrene and phagedena, balanoposthitis and venereal warts, lymphangitis, adenitis.

The Mixed Sore.—*So long as your patient has chancroid you may never be sure that he has not chancre.* This rule is without exception. A chancroid may readily conceal a chancre from the most experienced eye. A chancroid may refuse to heal because of complicating gumma.

A very large proportion of sores treated in the clinic as chancroids are actually chancres, for many cases of unsuspected syphilis date back to a "chancroid."

The Inflamed Chancroid.—While every chancroid is more or less irritated by its own secretions and contaminated by ordinary pyogenic microbes, the resulting inflammation is often insignificant unless accentuated by friction.

The chancroid at the preputial orifice is usually an interminable while getting well. The friction of shirt and drawers, or even the rubbing of the softest dressing, so irritates the sore that, though it may lose all its chancroidal characteristics and become a simple, sluggish abrasion, it lingers on week after week, taxing to the utmost the victim's patience and the physician's skill.

Chancroid underneath a long prepuce, however loose, usually excites so acute a cellulitis in the connective tissue of the foreskin as to cause inflammatory phimosis. This retains the secretions of the chancroid, which, bathed in this irritating pus and protected from effective treatment, promptly invades both glans and prepuce, and instead of healing tends rather to eat its way through the glans penis into the urethra or through the foreskin, at the same time setting up an intense inflammation, which may terminate in abscess, erysipelas, or gangrene. If the prepuce is retracted in a desperate effort to get at the suppurating cavity, paraphimosis complicates matters.

Destruction of the Frenum.—One of the commonest complications of chancroid is destruction of the preputial frenum. A chancroid appears in the sulcus at one or both sides of the frenum; as it enlarges it eats a hole in the frenum, leaving a narrow string, which soon gives way as well.

Gangrene and Phagedena.—The terrible phagedena which, until the era of antisepsis, was an imminent possibility for every case of chancroids, has almost

passed into oblivion with hospital gangrene and such ancient horrors. One can no longer imagine such a case as Ricord treated for several years, and which, commencing as a chancroidal bubo fourteen years before, was still an open ulcer at the knee.

Most "phagedenic chancroids" are gummata with a negative Wassermann reaction or granulomata or tuberculomata.

Lymphangitis.—Acute inflammation of the lymphatics running along the dorsum and sides of the penis toward the inguinal glands is a rare complication. Suppuration therein is much rarer.

Inguinal Adenitis.—Chancroid of the genitals causes inguinal adenitis or bubo. This complication occurs about once in every three cases. The bubo when bilateral is usually more severe on the side upon which the sore lies; but, on account of an abnormal lymphatic supply, the glands in the opposite groin may be the more inflamed. This is the so-called "crossed bubo."

The chancroidal bubo may be a simple inflammatory adenitis, the glands becoming large and quite tender, so remaining for a week or more, and then slowly resolving.

It may go on to periadenitis. The glands become matted together in irregular, tender masses adherent to the skin and to the subjacent tissues. When the inflammation reaches this stage it terminates by suppuration. When the abscess is incised or breaks, it usually forms a chancroidal ulcer. This is the so-called virulent bubo.

It has long been known that chancroidal pus, although it would remain virulent for many weeks if kept in a sealed tube, promptly lost its virulence when heated to a temperature of 105° F. It is, therefore, to be inferred that both "simple" and "virulent" buboes are due to infection by the streptobacillus, but that the heat engendered in the inflamed gland is sufficient to reduce its virulence sometimes to the point of rendering it temporarily innocuous; so that it only requires a few days of cooling off, as it were, in the open ulceration to regain its primitive vigor.[2]

Diagnosis

Always suspect syphilis. Do the Wassermann reaction once a week for a month. Always suspect granuloma.

The diagnosis of chancroid may be made by the microscope (which gives no negative assurance), by culture on blood agar, by the ancient and very trustworthy method of auto-inoculation,[3] or by confrontation (examination of the person from whom the sore was contracted).

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[2] Thus Dubreuilh (*J. de méd. de Bordeaux,* 1893, xxiii, 573) has reported an epidemic of chancroids producing 136 buboes. Of these, 27 did not suppurate; 43 were incised, the pus was sterile to culture and they healed rapidly; 51 became virulent, though seemingly sterile when incised; only 3 were virulent at the time of incision; and 12, which were open on admission to the hospital, were all virulent.

[3] To perform *auto-inoculation,* cleanse a spot on the outer side of the patient's thigh

But the really important point in the diagnosis of chancroid is its differentiation from true syphilitic chancre. The details of this differentiation are considered elsewhere; but it is not amiss to repeat once again that *no matter how sure you may be that a given sore is a chancroid, you cannot thereby make a negative diagnosis of syphilis;* for the same coitus that transmitted the chancroid may have transmitted syphilis, the chancre of which might not develop until after the chancroid was cured, or might develop on the chancroid, and be so insignificant as to escape the most careful scrutiny.

Treatment

Abortive Treatment.—A chancroidal ulcer not more than three or four days old may be completely destroyed by the application of pure nitric acid after anesthetization with cocain crystals. But the opportunity to apply such treatment is extremely rare. The ulcer can only be thus aborted when it is palpably very superficial. Unless every bacillus is reached and killed by the acid, such cauterization manifestly does more harm than good. The presence of older lesions in the immediate vicinity, therefore, contra-indicates this treatment.

Curative Treatment.—After the chancroid is more than four days old it should not be cauterized with chemicals in the hope of curing it. The first indication in many cases is the relief of phimosis (see below). If this is not accomplished, the chancroids will continue to spread. Circumcision in the hope of amputating a chancroid on the edge of the preputial orifice is doomed to failure. The wound will develop chancroid.

The number of the sure cures for chancroid attests their fallibility. Yet many methods are about equally successful for cases of no more than ten days' duration. Later than this the ulcer becomes so indurated that mild measures, calculated to reduce the infiltration are often more successful than energetic cauterization.

For the early cases, then, argyrol crystals applied twice daily and preceded by cleansing with water and drying, will cure the majority. If the sore is sensitive, it should be anesthetized with novocain crystals. Mercurochrome may be substituted for the argyrol.

An equally efficient treatment is to dry the lesion, apply novocain crystals, touch with a crystal of copper sulphate. This is repeated every second day

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with alcohol; then with a clean bistoury or pin wipe a little pus from the suspected sore; twirl the point of the instrument into the skin at the point to be inoculated just deep enough to draw the most minute drop of blood, smear the spot well with the virus, and clap on a vaccination shield. A "take" is announced by the appearance of a typical chancroid on the third day. This should promptly be destroyed by cauterization with pure nitric acid.

The mere appearance of a pustule or an ulcer after inoculation proves nothing. It must be chancroidal in type to be considered trustworthy evidence. If, after inoculation, there is still some doubt of the nature of the "take," *its secretions may be examined for the Ducrey bacillus with better prospect of success than in the original sore,* or the diagnosis may be confirmed by hetero-inoculation, or inoculation of another person.

and the lesion cleansed by immersion in water as hot as the patient can bear at least three times a day.

If the lesion is kept absolutely dry, it will heal. In order to accomplish this Ruggles kept the lesions constantly exposed to electric heat. During the war Bayard Clark kept his men in the sun all day long, with the penis exposed. I have seen good results from the use, every four hours, of tincture of iodin.

Whatever the treatment employed, some sort of cleansing should be attempted by the patient himself every three or four hours during the day.

Extensive lesions may be cured by curettage under general anesthesia and cauterization of the lesion with the high frequency spark or the electric cautery. The lesion is then kept soaked in a mercurochrome wet dressing, 1:5000.

Prevention of Bubo.—Warn the patient to avoid all violent exercise, and to walk about as little as possible in the hope of preventing suppurating bubo. Watch the groins carefully, and with the first sign of periadenitis, matting together of the glands, clap him into bed with a hot-water bag on his groin.

Do not, under any circumstances, paint the groin with iodin. It does no good and causes irritation of the skin, so that, if the bubo does eventually suppurate and burst, the surrounding skin is ready for inoculation.

Treatment of Complications.—*Cellulitis and suppuration* call for wet dressings, rest in bed, elevation of the penis, and incision, *secundum artem.*

Phimosis, whether congenital or inflammatory, is the most annoying complication of chancroid. A chancroid under a tight foreskin, unless aborted, demands prompt liberating incision. Dorsal incision rarely suffices; a bilateral incision affords much more satisfactory access to sores in the region of the frenum.

After the chancroids have healed a secondary circumcision is usually required.

Above all things, do not pull back a tight prepuce. The paraphimosis which will probably result is not easy to reduce, and is the most fertile cause of gangrene.

Partial erosion of the frenum forms a pocket which is very hard to clean. Tie a thread tightly around the remaining band, and it will cut through within forty-eight hours.

SUPPURATING BUBO

Suppuration in the inguinal lymph-nodes is clinically so much more common as a complication of chancroid than of any other lesion, that it seems well to consider it in this place, though the lesion should not be attributed to chancroid unless the association can be clearly shown to exist.

Chancroidal Bubo.—Chancroidal infection of the inguinal nodes is a suppurative adenitis and periadenitis. The nodes enlarge and become sensitive and painful. They become matted together into an inflammatory mass, which

breaks down into a multilocular abscess, which in turn bursts through the skin and forms a chancroidal ulcer of the groin.

The adenitis is occasioned by trauma to the chancroid through the friction of the clothes, or by retention of the secretions under a long foreskin. It usually appears after two or three weeks, and not infrequently begins just as the genital chancroid is healing, so that by the time the adenitis comes under observation the original lesion is healed. Indeed the French maintain that a period of weeks may elapse between the healing of the chancroid and the appearance of the adenitis; but I have never recognized this.

Treatment consists in rest, as complete as practicable to prevent suppuration. Once this has occurred it can best be controlled by the following treatment: The points of suppuration are punctured with a bistoury, since a scalpel makes too wide an incision, the pus squeezed out, and the cavities injected with a 10 per cent emulsion of iodoform in vaseline and this injection repeated every second day until the incisions heal, which they always do in a week, if the incisions are small enough to retain the vaseline. But failure results and chancroidal ulceration of the groin ensues, if the incisions are too extensive.

Chancroidal ulceration of the groin should be treated by thorough curetting of the lesions followed by thermocauterization repeated as often as seems necessary.

Tuberculous Inguinal Adenitis.—Acute or chronic suppuration in the inguinal nodes occurring spontaneously, and not due to chancroid or other lesion of genitals or lower extremity, is almost always tuberculous, though the acute onset, perhaps due to mixed infection, does not in the least suggest tuberculosis.

Treatment is by multiple incisions as small as may be, followed by curettage. The ensuing ulcerations are treated by Bier cups. Any attempt at complete enucleation of the infected nodes in the hope of getting a clean wound and prompt healing is almost certainly foredoomed to failure, and leaves, just as the curetting does, an ulcer that may well take eighteen months to heal; but whereas the ulcers following curettage are small and scarcely interfere at all with locomotion, the ulcer following complete adenectomy is large enough to result in almost complete disability.

The hygienic treatment for tuberculosis is of course obligatory, unless the prompt healing of the lesion and absence of tuberculosis in the scrapings show that the lesion was not after all tuberculous, and this we repeat is very rarely the case.

Gonorrheal Suppurative Inguinal Adenitis.—Suppuration in the inguinal nodes due to gonorrhea might be said never to occur in civil practice, though it is common enough in the army. The difference may be accounted for on physiological grounds. The lymph stream from the urethra, except from its balanitic portion, leads to the iliac nodes, not to the inguinal. Inguinal adenitis is therefore not a complication of urethritis, but of the balanitis accompanying

urethritis, and this is never neglected and irritated by hard marches in civil life as it is in the military.

Treatment is by incision and drainage.

Suppuration in the Iliac Nodes.—At Bellevue we have had several cases of suppuration in the iliac nodes, usually a complication of suppurative inguinal adenitis. The condition is readily recognized as an inflammatory mass in the inguinal region, beneath the abdominal muscles. It is to be treated by incision, curettage and drainage. Excision of the mass is, of course, out of the question, since it is everywhere adherent to the iliac vessels.

CHAPTER LXVIII

THE INITIAL LESION OF SYPHILIS

THE *initial lesion* (primary lesion) *of syphilis consists of the chancre and the adjacent adenitis.* It must not be forgotten that the inflamed lymph-nodes form as essential and characteristic a part of the initial lesion as does the chancre itself.

THE CHANCRE

The chancre is an eroded or ulcerated, painless infiltrate, arising at the site of syphilitic inoculation.

The chancre is primarily a lump. By bearing this in mind we distinguish it instinctively from chancroid, which is primarily an ulcer. The one is a lump, the other a hole.

This lump is commonly called the induration. The induration may be very extensive; it may form a large hard lump, projecting markedly above the surrounding tissues and having a diameter of perhaps an inch. But usually, in eight cases out of ten, it is small—one might almost say minute—and instead of projecting above the integument it is embedded in it. Thus, it may be felt rather than seen, and in appearance is rather insignificant than impressive.

The surface of this insignificant lesion is almost always eroded and moist, but it may be ulcerated, or it may be covered by an unbroken reddened integument.

It is *peculiarly hard and elastic,* as though a piece of cardboard were embedded in the integument. In order to appreciate this one must pick it up from the surrounding tissues and palpate it from side to side.

Pathology.—The chancre has the general characteristics of syphiloma. We find in a connective-tissue framework a mass of plasma cells, leukocytes—all the elements of an acute localized exudative inflammation. The vessels, especially the arteries, are infiltrated, irregularly thickened, and occluded by the characteristic "coat-sleeve" infiltration. The surface of growth is more or less necrotic, whence the erosion or ulceration. Proper staining shows spirochetes in the substance of the chancre.

This inflammation diminishes insensibly toward the border of the induration and extends into the surrounding tissue far beyond the apparent limits of the growth. The infiltrations in the vessel walls, in particular, extend beyond the palpable seat of the disease. Yet the depth of the chancre is almost nil. It

occupies chiefly the epidermal layer of the skin, encroaching but little on the true derma and the subjacent tissue. Hence it leaves no scar.

Multiple Chancres.—The most striking characteristic of chancre is its insignificance; next in order of importance is its uniqueness. Yet too much stress may be laid upon this. The chancre is usually single, to be sure, yet Papagaey, who collected 14,004 reported cases, found that in from 25 per cent to 33 per cent the chancres were multiple. This confirms other Continental statistics; yet multiple chancres are certainly much fewer in my practice. My records show only fifty-six among 549 cases examined —*i.e.*, one in ten.

But whether one in ten or one in three, the multiple chancre must be counted with, and *it is a grave clinical error to insist on the uniqueness of chancre as a diagnostic factor.*

The number of multiple chancres is two in 78 per cent of cases (Papagaey). My father has recorded one case of eleven and one of twelve chancres (four on the left breast, eight on the right). Fournier has seen a patient with twenty-three (seven on the left breast, sixteen on the right).

The location of multiple chancres is almost exclusively genital. Only 2 per cent of extragenital chancres are multiple (Fournier). Chancres of the breast are quite frequently multiple.

FIG. 179.—DOUBLE CHANCRE. (Paromagian)

It is sometimes possible to auto-inoculate chancre if the inoculation is performed before the lesion is ten days old.

Types of Chancre.—The three chief types of chancre are:

1. The eroded chancre
2. The ulcerated chancre
3. The indurated papule

The Eroded Chancre.—From 60 to 80 per cent of chancres assume this form. It is most characteristically exemplified by chancres within the preputial cavity.

The induration is rounded, circumscribed, and thin, sometimes so thin as to be scarcely perceptible except to the most delicate touch (parchment chancre).

The induration may be so slight as to be clinically imperceptible. Fournier noted this absence of induration seven times in three hundred cases.

Its color is usually a dark, vinous, or "raw-meat" red. Rarely it is of a dusty gray color (the color of lard). It may be covered with little petechiæ.

Its surface is usually flat. It may be a little elevated above the surrounding integument, or a trifle sunken below it, or surrounded by a slightly elevated ring of induration

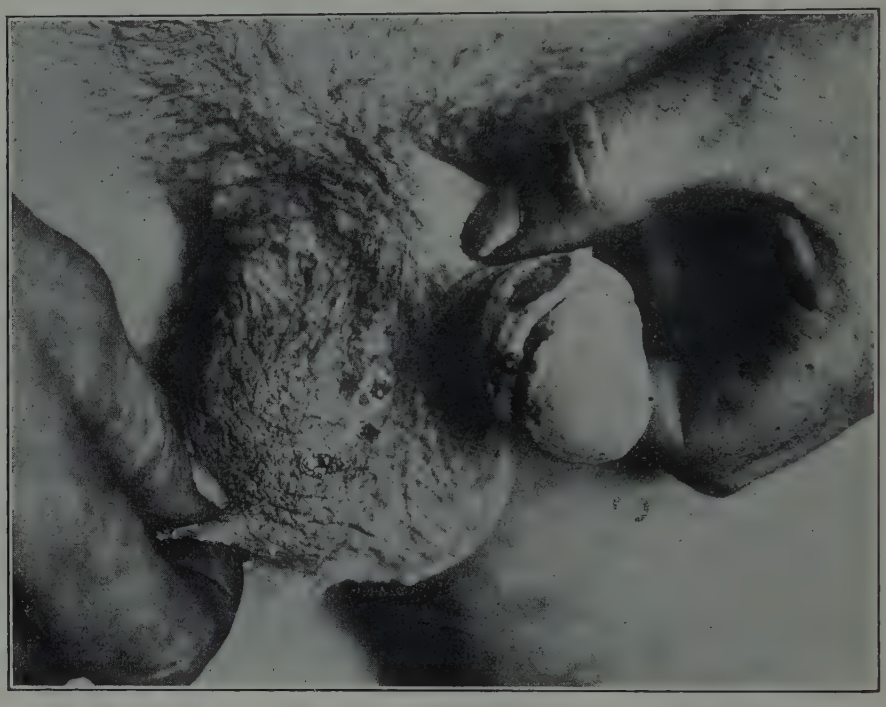

FIG. 180.—HEALING MULTIPLE CHANCRES; MUCOUS PATCHES ON SCROTUM. (Paromagian)

The eroded surface is smooth and polished. It emits a slight seropurulent discharge. It may be covered by a crust or a false membrane, due to infection by skin cocci.

The Ulcerated Chancre.—This is the type of chancre described by Hunter, and to it the title "Hunterian chancre" is, therefore, peculiarly applicable. It is far less common than the eroded chancre.

It has a relatively large indurated base topped by a distinct ulcer. The ulcer is due to extensive necrosis, and the necrosis is proportional to the interference with circulation; thus the thinner induration forms an eroded chancre, while the more nodular mass ulcerates.

The ulcer extends into the true derma. Its edges are sloping, not undermined, and give the sore a sort of funnel shape; the base is granulating and

may be covered by a false membrane; the discharge is slight and serosanguinolent.

The clinical picture of ulcerated chancre is that of a neoplasm eaten out by an ulcer, not that of an ulcer surrounded by an inflammatory ring. The neoplasm may be embedded within the skin; but pick it up, and you will realize that it is a distinct lump with an ulcer in the center.

The Indurated Papule.—This is the rarest type of chancre. It occurs usually in situations where the integument is so dense and thick as to prevent very extensive development of the neoplasm. The induration consequently remains a small, dark-red, flat papule. As it begins to heal the surface becomes scaly.

Complications of Chancre.—The chief complications of chancre are:

1. Lymphangitis and edema
2. Chancroid (mixed sore)
3. Simple inflammation
4. Phagedena (gangrene)
5. Transformation into a mucous papule
6. Vegetations

Lymphangitis.—Corded lymphatics, running from the chancre to the adjacent glands, along the dorsum of the penis, are not often seen.

But in certain localities, such as the prepuce and the labia majora, a great mass of lymphatic induration may surround the chancre, or small similar masses may lie adjacent. Such a complication obstructs the lymphatic flow and causes considerable edema.

"Mixed" Sore.—As chancroid itself is rare among the upper classes, so is the mixed sore, the combination of chancroid and chancre. Among the chancres seen in the dispensary, however, many are "mixed sores."

The possible combinations of chancre and chancroid are three:

1. The chancroid may appear, flourish, and be cured, and from its remains the chancre may arise.

2. The chancroid may overlap and overshadow the chancre, so that the latter is suspected only from the induration remaining after the sore heals, or proven by the appearance of secondary syphilitic lesions, or a positive Wassermann reaction.

3. A true chancre may become chancroidal.

Of the three types, the second is the one commonly observed. The presence of chancre is not even suspected until the chancroid in healing begins to take on a suspicious hardness, or until a roseola breaks out all over the patient. *While the patient has an active chancroid, therefore, one can never assure him he has not true chancre.*

Inflamed Chancre.—The friction of clothes, or any other form of trauma, may so irritate the chancre that it becomes acutely inflamed; yet this is unusual. As a rule, the pyogenic microbes have no effect upon chancre beyond encouraging ulceration.

Gangrenous and Phagedenic Chancre.—The obstruction to circulation in the indurated base of a chancre is habitually sufficient to excite desquamation and exudation from its surface. Exceptionally, it is so marked as to cause *gangrene* of the dermis. Such a complication is of no great importance. Phagedena is far rarer. Indeed, the occurrence of phagedena is presumptive evidence that the sore is not chancre. It is probably gumma.

Transformation into a Mucous Papule.—Chancre upon the mucous membrane or between moist folds of skin may, at the time of the first, general, secondary outbreak, become a typical mucous papule. The fact requires no further comment.

Vegetations.—Soft warts may surround the chancre. Their presence is accidental, and can scarcely be called a complication.

Duration.—The chancre usually lasts four to six weeks, though some trace of induration may remain many months.

Reinduration of the chancre, which simply means recurrence of syphilitic inflammation in a chancre partially or wholly cicatrized, may prolong its duration indefinitely.

Fournier relates that he has seen a chancre run its whole course in two weeks. This must be about the minimum. Yet patients will often say that their chancres only lasted a few days, for they are careless observers. Their testimony merely bears witness to the clinical insignificance and painlessness of this lesion so fraught with grave consequences.

Diagnosis.—During the first week of a chancre spirochetes may readily be found in its secretion. During the ensuing weeks they become less numerous here but may often be obtained by aspiration of the inguinal glands. The Wassermann reaction often becomes positive in the second or third week, almost always in the fifth week, and always between the eighth and the tenth weeks following the appearance of the chancre.

Treatment.—A daily wash with warm water, protection from friction of the clothes, and the application of any simple dusting powder is all the treatment the chancre needs.

But the disease requires instant and energetic specific treatment.

THE ADENITIS OF CHANCRE

Syphilitic inflammation of the group of lymph glands adjacent to the chancre is part of the initial lesion. It is as constant and typical as the chancre itself. Indeed Fournier failed to find it only thrice in five thousand cases. It appears in the second week after the outbreak of the sore.

Inguinal adenitis is usually bilateral; if not, it is usually on the side corresponding to the chancre. Exceptionally the lymphatics so anastomose that the adenitis is on the opposite side.

Symptoms.—The adenitis appears in the second week after the appearance of the chancre, usually on or about the tenth day. It reaches maturity in two

or three days, and presents the following characteristics: multiplicity, moderate size, absence of periadenitis and of all acute inflammation, hardness, slow resolution.

There is always a group of glands involved; indeed, inguinal adenitis usually shows involvement of a group in each groin, but the one rather more enlarged than the other.

This group, or pleiad, as Ricord appropriately termed it, is made up of one large gland, rarely more, surrounded by a group of lesser ones.

The larger gland scarcely attains the size of a cherry and may be much smaller; the lesser ones are the size of peas.

Unless there is mixed infection the glands are neither painful nor tender. They are freely movable beneath the skin, upon the subjacent parts, and upon one another. The skin over them is not discolored; they do not suppurate. This complete absence of periadenitis is one of their most striking characteristics.

Hardness.—"The hardness of the glands is the hardness of the chancre"; such is the routine statement. The clinical facts do not quite bear it out. Though the glands may be as hard as the chancre, and when so are typical, in the larger number of cases they are distinctly elastic.

Slow Resolution.—The great virtue of syphilitic bubo is that it persists many weeks after the chancre has disappeared and may lead to the discovery of the scar of a healed chancre. It usually persists three months.

Unusual Varieties.—The bubo may be abnormal, inflamed, or "mixed."

Abnormal Bubo.—Exceptionally the bubo consists of a single very large gland, or the large gland is altogether lacking.

Inflamed Bubo.—Inflamed bubo is much more common than inflamed chancre. The pyogenic bacteria multiply upon the chancre and from it enter the lymph current, yet may not cause much local irritation.

The bubo of labial or buccal chancre is habitually a large, tender, inflamed mass.

"Mixed" Bubo.—Syphilitic adenitis may be complicated by chancroid or by tuberculosis.

Chancroid and chancre combine to make a "mixed" sore and a "mixed" bubo. In both instances the characteristics of the chancroid lesion overshadow the other.

Tuberculosyphilitic glands I have never seen. They are said to assume the tuberculous type.

Diagnosis.—The typical group of one large uninflamed gland surrounded by a lot of little ones—all of them hard, insensitive, and not adherent—is so unmistakable that a discussion of its differentiating characteristics is all but superfluous.

The insensitive, hard, movable glands of syphilis can scarcely be confused with the inflamed, tender, adherent nodes of chancroid; though, as we have already said, the latter may conceal the former.

The diagnosis is certified by the discovery of spirochetes or by the Wassermann reaction.

CHAPTER LXIX

GONORRHEA: ITS SOCIAL ASPECTS AND PREVENTION

The importance of gonorrhea to the community rests chiefly upon five factors: first, its transmissibility by sexual intercourse; second, its rebelliousness to treatment, its capacity to extend to the uttermost parts of the urinary and genital mucous membranes and its involvement, no less terrible for being rare, of the whole economy in gonococcus septicemia; third, its chronicity and latency, which deceive the patient and even his physician into the belief that the disease is cured until a new outbreak in the patient himself, or infection of a sexual partner, or, if the patient be a parturient woman, of the eyes of her child, reveals the inveteracy and virulence of the disease; fourth, the ease with which female children are indirectly contaminated, and the hospital and family epidemics resulting therefrom; fifth, its sterilization of both sexes by occlusion of fallopian tube and vas deferens.

PREVALENCE OF GONORRHEA

The prevalence of prostitution in our cities makes gonorrhea endemic among their population; smaller towns suffer in proportion to the laxity of their morals and their proximity to urban centers, while the countryside is subjected to epidemics of the disease by the return of the Prodigal Son. Morrow [1] estimates that 60 per cent, Forscheimer [2] that 51 per cent of the adult population of the United States have had gonorrhea. He adds: "Twenty per cent of these young men will become infected before they are twenty-one, over 60 per cent before their twenty-fifth year, and more than eighty per cent before they pass their thirtieth year."

Among women, gonorrhea, though more mutilating, is less common than among men. The proportion of infected men to infected women is estimated at about 13 to 1. Among children, the disease occurs chiefly in the form of gonorrheal ophthalmitis acquired at birth, and as hospital epidemics of vulvovaginitis due to indirect infection.[3]

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[1] *Social Diseases and Marriage.* Also *Tr. Am. Soc. San. & Moral Prophylaxis,* 1906, i, 18.

[2] *Boston M. & S. J.,* Aug. 6, 1908. The statistics of gonorrhea in Germany and Austria are given by Erb (*München. med. Wchnschr.,* 1906, liii, p. 2329, and 1907, No. 31) and Blascko (*Ztschr. f. Bekämpf. d. Geschlechtskrankh.,* 1907, vi, No. 1).

[3] "It has been shown by a number of observers that among the poorer classes of New York City, a certain proportion, commonly estimated at 10 per cent, of female infants and young children are infected with gonorrhea, in an active or latent form, or as carriers.

European statistics as to the prevalence of gonorrhea are far more pessimistic than our own. This difference should not be cynically attributed to "Anglo-Saxon prudery." Climatically, racially and educationally our people are more protected than are the inhabitants of Europe against sexual license and the diseases attributable thereto. At present our religious protection seems on the wane. Its place is being taken by the campaign for social hygiene and efficiency, whether to an advantage or a disadvantage remains to be seen in time.

Prevalence in the Military Service.—Venereal disease is the pest of the army and navy, and though gonorrhea is not so dangerous to life and function, with the exception of the generative function, as syphilis, it nevertheless stands far ahead as the cause of temporary disability. Before the War, gonorrhea stood first among army diseases in point of prevalence. Thus, during 1907, 12 per cent of the troops had gonorrhea; as a cause of non-effectiveness it stood first—36.93 per cent—with syphilis second, chancroid third and tuberculosis fourth. But as a cause for discharge it stood fourth to tuberculosis, syphilis and insanity. Only five deaths due to gonorrhea were reported in the army during the preceding decade.

The War, while increasing the number of admissions for gonorrhea, slightly diminished its relative importance. Thus in 1919 it stood fourth in admission to tonsillitis, bronchitis and mumps, and second, in days lost, to tuberculosis. In 1919 the venereal diseases accounted for 13.4 per cent of absentees from duty, in 1920 for 16.5 per cent, in 1921 for 17.9 per cent.

Perhaps the most striking illustration of the inaccuracy of statistics concerning the prevalence of venereal disease is furnished by a comparison of the statistics reported by the medical departments for the armies of different countries. The wide range in the figures bears vivid testimony to the fact that each country bases its statistics on a different set of facts. Thus in the French army the prevalence of venereal disease hovered for years between 2 and 4 per cent. One might almost suspect that the figures were "pegged," though doubtless they merely show that the absence of routine physical examination for venereal disease and a lack of interest in its minor manifestations and sociological significance deprive the published statistics of any real value.

The widespread prevalence of this disease constitutes one of the most difficult problems in hospital management. No institution or hospital for children, however efficiently managed, has escaped ward epidemics from time to time. . . .

"As an example of typical conditions, the Scarlet Fever Service at Willard Parker Hospital for 1913 will be found instructive: . . .

"Three hundred and thirty out of 791 female patients on admission had sufficient evidence of vaginal infection to demand their segregation, and of these, 21 subsequently developed clinical and bacteriological evidence of the disease and were transferred to the infected wards. It is not to be understood that all of these 321 cases had gonorrheal infection even in the latent form, but experience goes to show that a large number undoubtedly did. Without prolonged and repeated examinations, causing an unjustifiable annoyance to the patients, this point cannot be accurately determined."—*Bull. N. Y. Health Dept.*, Mar. 7, 1914.

DURATION OF THE DISEASE

"A gonorrhea begins and God alone knows when it will end," said Ricord more than a generation since; and the aphorism is as true to-day as the day it was uttered. Where there are few glands, *e.g.,* in the conjunctiva, gonorrhea runs an acute course and then disappears; but in the genital passages it shows a marked tendency to become chronic by causing chronic glandular catarrh and periglandular sclerosis.

From the male urethra and its glands the gonococci usually disappear within six months. Persistence of gonococci for more than eighteen months in the male is exceptional. The catarrh may continue longer than this, kept alight by the associated microörganisms that persist after the gonococcus has disappeared.

The exceptional case whose gonococci remain alive and at least potentially virulent for two or three years—I have known but one case to persist any longer —proves the possibility of an indefinite infectiousness.

Indeed, the infectiousness of gonorrhea in the male is comparable to that of typhoid fever. Most cases last an indefinite number of weeks and are cured. A small number continue infectious. It may be a matter of great delicacy to determine the persistent infectiousness of a given case. But this does not alter the fact that almost all are cured within a few months.

But gonorrhea in the female is another matter. Conservative gynecologists are entirely unwilling to set any limit to its infectiousness and are confessedly incompetent in some instances to cure it, in others to say whether it is cured or not. I have known a woman to infect her partner seven years after her own infection.

To be sure many women, like most men, recover from gonorrhea in a few months. But the exceptions in women are much more indefinite in duration, much more difficult of diagnosis, much more rebellious to treatment.

The vulvovaginitis of young children is exceedingly intractable. It commonly lasts for many months.

GRAVITY OF THE COMPLICATIONS

The local inflammation, which is all that most patients see in a gonorrhea, is actually the least of its dangers.

Apart from the danger of conjunctival infection, which is common to both sexes but rare in the adult, the complications due to direct extension of the disease are different in the two sexes.

In man the complications are almost entirely under the control of the skillful physician with a faithful patient. But both are rare, and patients in the poorer classes have neither the means nor the leisure to avail themselves of the resources of medicine. Among our dispensary patients the greater number suffer acute posterior urethritis, and some 10 to 20 per cent suffer acute epididymitis, which in perhaps one-quarter of these is bilateral and results in sterility. Chronic

urethritis or prostatitis results in fully 70 or 80 per cent of these cases, and urethral stricture in a small percentage.

Among our wealthy patients, who are well treated from the onset of their disease, epididymitis complicates less than 5 per cent, chronic urethritis and prostatitis less than 20 per cent, and stricture is altogether exceptional. But even the wealthiest patient may not be willing or able to command good treatment at the onset of his gonorrhea, so that more than half the patients treated in the office of the specialist suffer from chronic gonorrhea when first seen.

Such complications as prostatic and periurethral abscess and pyelonephritis are rare in the clinic, extremely rare in private practice.

In women, on the other hand, grave complications are common. Invasion of the uterus, the uterine adnexa, and the peritoneum were noted in 40 per cent of the women reported to the Committee of Seven of New York.

This invasion of the female generative organs takes places either at the time of infection, after menstruation, or after the birth of a child. For the gonorrhea may subside and become latent in the glands of the uterine cervix until menstruation or pregnancy opens new areas to invasion by the gonococci. By these the child's eyes are endangered at birth, its mother's uterus and tubes immediately thereafter.

SOCIAL IMPORTANCE OF GONORRHEA

The social importance of gonorrhea depends upon its prevalence, its transmissibility, its grave results in women and children, and the sterility in which it so often results.

A disease that attacks more than half our young men, a disease that affects thousands of children and hundreds of thousands of women, is important to society by its prevalence alone.

A disease that enters the family almost exclusively through illicit sexual contact, a disease that may be transmitted long after the patient thinks himself or herself well, a disease that may be transmitted to the wife from the prostitute via the offending husband, a disease that may be passed from the wife, thus innocently infected, to the eyes of her infant at birth or to its genitals thereafter, is eminently important to society.

A disease that incommodes the man and may invalid the woman, a disease that is the occasion for most of the major gynecology of to-day, a disease that unsexes thousands of women, that makes chronic invalids of many, that kills not a few, a disease that in this country causes from one-quarter to one-half of the congenital blindness, that is accountable for about one-third of the blind in our asylums, is a real peril to society.

A disease that causes fully 50 per cent of the involuntarily sterile, or one-child sterile marriages, that destroys the power of procreation in man as well as in woman, is indeed a peril to the race.

SOCIAL REMEDIES

Three types of remedy for gonorrhea are submitted to society:

Individual prevention
Methods of dealing with prostitutes
The moral campaign

To discuss fully the relative merits of the three would require a volume.[4] Suffice it to say here that an individual preventive injection of the urethra after a suspicious intercourse, though diminishing greatly the danger of infection, does not entirely eliminate it. Segregation and reglementation of prostitutes is neither acceptable nor successful, while the moral campaign, the attempt to bring venereal disease and all sexual matters out into the light of day, seems the only way to get at the root of the evil.

Gradually and in the face of the utmost official cynicism the failure of the reglementation of prostitutes to protect the community's morals and health is being recognized. Japan closes the yoshiwara, France and Germany are debating the topic of reglementation anew. In our country reglementation is impracticable. It fails in theory by not quarantining the males, in practice by not quarantining the seduced housemaid or shop girl, or the errant widow.

The moral campaign of education to old and young still has its spurs to win. It is very full of promise. The notion that child and bride need education in matters sexual, and that the boy needs clean ideas on these subjects is a new one. But such education can scarcely fail to save many innocents from venereal disease and from moral woes far worse.

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[4] The important publications on these subjects are discussed in the various societies of social hygiene. Reference may be made to: *Social Hygiene, Bull. soc. franc. de prophylaxis sanitaire et morale, Mitteil. deutsch. Gesellsch. z. Bekämpf d. Geschtechtskrankh.*

CHAPTER LXX

GONORRHEA: THE GONOCOCCUS

THAT the gonococcus is the cause of gonorrhea is no longer a subject for discussion. Ricord's *"recette pour attraper la chaude-pisse"* is answered by the aphorism, "The most beautiful woman in the world cannot give what she has not got." No person can impart or acquire gonorrhea except by imparting or acquiring the gonococcus.

The gonococcus is a non-mobile diplococcus, occurring within as well as outside of pus cells. It stains readily with the familiar aniline dyes. It does not take the Gram stain. It will not grow on the usual culture-media. It produces endogenous toxins. It cannot be inoculated upon animals.

Microscopic Characteristics.—When a drop of gonorrheal pus is properly stained and examined through an immersion lens of one-twelfth aperture, the gonococci seen present the following characteristics:

1. They are diplococci. Each individual of a pair is D-shaped or coffee-bean shaped, with the flat, or slightly concave, border opposed to its fellow, so that the couple form an ovoid made up of two separate hemispheres. The length of the pair averages about 1.6 μ, and the interspace is about half as wide as either segment.

2. The diplococci are found grouped in pairs, fours, and other multiples of two, showing a tendency to rectangular disposition, in marked contrast to irregular massing of staphylococci and linear arrangements of strepotococci.

3. The gonococcus, when it occurs in pus, is found both within and outside of the pus cells.[1] The most charactertistic groups are met with inside the cells. The extracellular gonococci may be scattered or irregularly grouped, but the intracellular specimens present a greater regularity of arrangement. Without being mathematically distributed, there is still a certain symmetry in the grouping, an absence of jumbling, which the observer soon learns to appreciate at a glance (Plate IX, Figs. 1, 2).

Such are the characteristics of the gonococcus. It is a double D diplococcus occurring intracellularly and in typical groups. But these characteristics are sometimes shared by other bacteria met with in urethral pus. We must look further for a distinguishing feature. This we find in the reaction of the gonococcus to the Gram stain.

[1] There is no close clinical relation between the intracellular or the extracellular position of the gonococci and the grade or the stage of the inflammation. Every specimen contains gonococci both inside and outside the cells, and in no definite proportion.

Gram Reaction.—*Gonococci do not take "the Gram."* They are "Gram negative." This means that if these cocci are stained first with an aniline dye and then with Lugol reagent the resultant stain may be washed from them, from the cells, from many other bacteria, but *not from most staphylococci.* Hence, when the Gram stain is applied, a thorough washing with alcohol leaves the cells and gonococci colorless, while the pseudogonococci stand out in bold relief, stained darkly by the combined color of the aniline dye and the Gram stain.

In order to make the effect of the Gram stain more apparent, it is customary to restain the cells and gonococci with a contrasting color (*e.g.,* Bismarck brown), in order that the true gonococci may be visible for direct comparison with the false (Plate IX, Fig. 2).

Preparation of the Specimen.—Every practitioner is by no means competent to perform and interpret the Gram stain; but any one who can smear a slide and focus a microscope may become competent by practice.

1. *The Smear.*—A very small drop of the pus to be examined is placed upon a clean glass slide. Upon this another slide is dropped, the two pressed together and slid apart. This leaves each covered with a thin film of pus, the thinner the better. Each is then dried by evaporation at a gentle heat and fixed by rapidly passing it three or four times through the flame of a spirit lamp or a Bunsen burner.

2. *The First Stain.*—One of the films is now covered with Paltauf's solution.[2]

This is left on for three minutes and the excess shaken off. *No water or alcohol* may be applied at this juncture. The slide is immediately blotted and flooded with Lugol's solution.

3. *The Lugol.*—Lugol's solution is made up as follows:

Iodin 1 part
Potassium iodid 2 parts
Distilled water 300 parts

This is applied for precisely two minutes by the watch.

4. *The Alcohol.*—As soon as the slide is removed from the Lugol solution it should be washed with absolute alcohol for precisely thirty seconds.

5. *The Contrast Stain:*

Carbolic acid 2 parts
Saturated aqueous solution of Bismarck brown 98 parts

If the decolorized smear is covered with this solution for three to five minutes and then rinsed in water, it acquires a light-brown tint, and under

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[2] Aniline oil, 3 c.c.; absolute alcohol, 7 c.c.; distilled water, 90 c.c. Shake for two minutes. Filter through moistened paper until filtrate is clear. Add two grams of Grübler's powdered gentian-violet. Set aside for twenty-four hours. Pipette supernatant fluid as required.

This solution keeps well for six weeks.

the microscope the cells and gonococci appear yellowish and in marked contrast to the deep purple, almost black, pseudogonococci.

A more prolonged staining with the brown gives the gonococci a deeper color, which is not so readily distinguished from that of the pseudogonococci.

Such is the technic of staining the gonococcus, which may be employed by any one having an elementary familiarity with medical microscopy. The essentials likely to be overlooked are the *precise* staining, by the watch, employment of *absolute* alcohol, and exclusion of *all* water until after counterstaining.

GONOCOCCUS CULTURE

The gonococcus can be made to grow only on special media and under special conditions.

The growth of gonococci in laboratory culture is relatively slow. They are aërobic and facultative anaërobic. The colonies remain rounded and usually do not run together. They are grayish in color and slightly translucent. Growth ceases in about forty-eight hours. Examination should therefore be made at the end of the second day. To continue the growth it must be shifted to a new medium every three or four days or oftener.

The vitality of the gonococcus is slight whether in smears or in culture. On most media the cultures live but a few days. Desiccation kills it in a few hours. But Heiman has cultivated the gonococcus from a thick drop of pus twenty-nine days old. It is killed by a temperature of 45° C., and ceases to grow below 30° C. Any weak antiseptic rapidly destroys the gonococcus *in vitro*. Cultures from urine must be made without delay and before the urine cools.

DIAGNOSIS OF THE GONOCOCCUS

The gonococcus is usually distinguished from staphylococci and other Gram-positive cocci by the Gram stain. Errors in diagnosis by the Gram stain, apart from those due to ignorance and carelessness, have three sources, viz.:

1. There are other Gram-negative cocci from which the gonococcus can only be distinguished by culture.[3] Such are the *Micrococcus catarrhalis,* the *Diplococcus intracellularis,* and certain chromogenic cocci.

Happily none of these organisms, except the *Micrococcus catarrhalis,* have been identified in the genito-urinary tract. None of them, except the *M. Catarrhalis,* is believed to cause urethritis. The urethritis caused by *M. catarrhalis* is probably insignificant, and not to be clinically mistaken for acute gonorrhea. I have encountered it but once in several hundred cases.

2. In a small percentage of cases the normal urethra, and in a somewhat larger percentage the normal vagina, contains Gram-negative cocci which can

[3] *Cf.* Zupink, *Berl. klin. Wchnschr.,* 1906, No. 52; Wollstein, *J. Exper. M.,* 1907, September 21st; Elser and Huntoon, *J. Med. Research,* 1909, xx, No. 4, p. 369.

usually, but not always, be differentiated from the gonococcus by their form, size, and extracellular position. These organisms fail to grow on the ordinary culture-media.

3. The most frequent source of error is the fact that in smears as well as in cultures, the common *staphylococci may be Gram-negative as well as Gram-positive.*

But these confusing factors, that render the diagnosis by Gram alone quite valueless, apply almost exclusively to chronic urethritis. For clinical laboratory diagnosis of acute genital gonorrhea it is only necessary to identify a Gram-negative, intracellular diplococcus.

The gonococcus in the conjunctiva and in joint exudates is equally unmistakable.

Concerning serum reactions Elser and Huntoon state that:

"When properly controlled, agglutination tests serve to differentiate the various groups from each other, providing the strains tested are sufficiently agglutinable. Diagnostic difficulties may arise in connection with certain gonococcus strains. These are unusually sensitive to the action of normal and of group agglutinins and may yield higher values in the presence of a meningococcus immune serum than moderately agglutinable meningococcus strains.

"Absorption tests served to differentiate the various groups of Gram-negative cocci from each other and to establish the identity of the agglutinable and inagglutinable meningococcus strains."

COMPLEMENT FIXATION TEST

The gonococcus complement fixation test of Schwartz and McNeil[4] is peculiar only in that the antigen employed is made from mixed strains of gonococci. The original antigen was made from Torrey's eleven different strains and as various ones of these died off, or were lost, they have been replaced by others.

The reaction becomes positive rarely before the fourth week, but usually in the sixth to the eighth week. It never becomes positive in cases that are so successfully repressed as never to have any considerable infection.

The reaction usually remains positive as long as there is any active gonorrheal infection in the patient's body. Thus a persistent joint lesion or, in the female, tubal infection, may keep up a positive reaction long after the urethral infection has been cured. Two exceptions are to be noted in the time of disappearance of the positive reaction as follows:

1. The urethral lesion may become so slight and superficial that the complement fixation test becomes negative before the last gonococcus has disappeared.

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[4] *Am. J. Sc.*, May, 1911, September and December, 1912; see also confirmatory articles by Swinburne, Keyes and Schmidt, *Am. J. M. Sc., Arch. of Diagn.*, July, 1911, *Am. J. M. Sc.*, January, 1912: *Tr. Am. Urol. Ass.*, 1911.

I have never known this to occur except with a mild chronic anterior urethritis that would react brilliantly to the passage of a sound in the form of an acute obviously gonorrheal urethritis. This check can, therefore, be relied upon and the combination of a negative gonococcus fixation test with absence of reaction to the passage of a sound is an almost certain guarantee of cure.

2. The fixation test usually remains positive two to six weeks after all clinical evidence of infection has disappeared from the urethra and its glands. But it may persist for months. Such a persistent positive reaction is extremely unusual, but I have seen three men with a positive gonococcus reaction a year after the last trace of gonorrhea had disappeared from the urethra; each of them was repeatedly tested by culture for gonococcus with negative results. Two of them married without medical sanction and apparently did not infect their wives, though the reaction of one of these was still weakly positive six months after matrimony. I do not know what focus of infection kept up the reaction in these cases.

The reaction presents two interesting medicolegal features:

1. If within two weeks of the time when a fresh urethral discharge appears the patient's blood is found positive the discharge is probably a relapse from a previous infection. If negative it is doubtless a new infection.

2. The reaction of a person who has not recently had a gonorrhea cannot be made positive by the injection of gonococcus vaccines; but if the complement fixation test has been positive within the preceding six months and vaccines are given it may become positive again.

Diagnostic Value.—The accuracy of the complement fixation test, like that of gonococcus culture, varies in accordance with the skill and experience of the technician; but, exception made for infection confined to the anterior urethra, technical errors are much less likely to interfere with the validity of the complement fixation test than with gonococcus culture. Positive culture is certain evidence that an infectious lesion persists in the urethra and the positive complement fixation test is not evidence. Nevertheless the best laboratories exceptionally report "false positive" gonococcus fixation and therefore the practitioner will be wise to rely upon the complement fixation test only for confirmation of the diagnosis of the presence of gonorrhea.

GONOCOCCUS VACCINES

Gonococci produce only an endotoxin derived from dead and disintegrated microörganisms. Thus the toxin may be measured in units of bacteria. Accordingly, one speaks of a solution containing 20,000,000 or 1,000,000,000 gonococci, meaning a solution containing the toxins of that number of dead bacteria.

Teague and Torrey [5] have shown that the serum of an animal immunized to

[5] *J. M. Research,* December, 1907.

one strain of gonococcus does not cause fixation of complement when tested against an antigen obtained from another strain. Following up this line of investigation Torrey was able to differentiate eleven strains of gonococci in New York City, and most of the stock vaccines now sold are from a mixture of these eleven strains.

It is difficult to compare the efficacy of autogenous and stock vaccines on a scientific basis. Autogenous vaccines have the advantage of giving a definite product distinctly and certainly applicable to a given case, but they have the disadvantage of requiring from two to four days' preparation.

Local pain from the injection is slight, local inflammatory reaction rare. General toxic or febrile reactions are not unusual if the vaccine treatment is begun at a high dose or pushed rapidly. But the discomfort of a reaction accompanied by a temperature of 103° F. and lasting not more than twelve hours is the most that may be expected.

Dosage.—The vaccines have been employed at an average dose of 10,000,000 to 20,000,000, increased to a maximum of 50,000,000. Such doses are too small. One should begin at 50,000,000 and increase by 50,000,000 or more at each dose, unless the symptoms are controlled, or the reaction is marked, until a dose of 200,000,000 is reached.

So long as gonorrhea remains localized upon the genital and urinary mucous membranes it excites no systemic reaction, and is seemingly uninfluenced by the injection of vaccines. Individual instances of the cessation of an intractable gonorrhea under the administration of vaccines prove nothing. Chronic gonorrhea is, as a rule, quite uninfluenced by the vaccine treatment. I have not even noted an increase in the gonococci in the urethral discharge, though certain Continental authorities rely upon the vaccine to excite a discharge if gonococci are present (focal reaction).

It is my practice, whenever a gonorrheic develops fever or any symptoms suggestive of acute epididymal, prostatic, or periurethral complications, to administer 50,000,000 gonococci and to follow this two days later by the same dose if all is well, by double the dose if the symptoms continue.

One may thus perhaps abort the threatened complications.

When the metastatic (*e.g.,* epididymal) focus is established, however, I have seen no positive good result from vaccine.

The vaccine treatment finds its most rational application in the treatment of systemic gonorrhea. Thus many authorities rely upon frequent injections of from 50,000,000 to 500,000,000 killed gonococci. I at one time believed in this treatment; but a large experience at Bellevue Hospital has left me skeptical.

Moreover, the painful lesion of many so-called cases of chronic gonorrheal arthritis is an organic one, an exostosis or a change in ligament or synovial membrane due to a gonococcal inflammation that has passed, and preëminently unsuited to any vaccine treatment.

Gonorrheal septicemia sometimes reacts brilliantly, sometimes not at all. Autogenous vaccines should be used if possible.

ANTIGONOCOCCUS SERUM

The antigonococcus serum employed in this country is that of Rogers and Torrey.[6] The serum, like the vaccine, is polyvalent. Two c.c. of the serum are injected every day or every second or third day.

The only reaction that one may anticipate is a varying amount of local swelling, redness, heat and soreness around the point of injection. This does not occur in every case, and is caused not by an antibody, but by the serum itself. As the same serum has been found to cause this reaction in one individual but not in another, it is partly referable to the idiosyncrasy of the patient (Rogers).

Results.[7]—The results reported from the use of the serum are quite similar to those reported from the vaccine. I have not experimented with the serum.

Rogers claims good results in 85 per cent of early joint cases, and some good in late cases, if treatment is continued for a month or more. Herbst, using three times the usual dose, achieved very satisfactory results in all chronic joint cases, but nothing in epididymitis and acute arthritis. Swinburne warmly advocates the serum at the onset of epididymitis, stating that in twenty-seven cases so treated the pain was relieved in forty-eight hours.

IMMUNITY

The gonococcus confers a relative immunity to the person who harbors it. He can usually not be reinfected by a woman upon whom he has conferred the disease. Moreover, relapses of a given gonorrhea are almost invariably less severe than the initial outbreak.

But the immunity that persists after a cured gonorrhea is of the slightest. Subsequent attacks are usually milder than the initial one; but they may be quite as prolonged, quite as complicated.

Marital immunity is a curious phenomenon. It consists in this: that a man having gonorrhea and bestowing it upon a woman cannot, when cured, be reinfected by his still-infected partner. One may well doubt the universality of such a rule, the permanence of such immunity. Yet we see it illustrated by the infection of the interloper who presumes upon the apparent health of his lady's lawful husband.

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[6] *J. Am. M. Ass.*, January 27, 1906, and September 14, 1907.

[7] Rogers and Torrey, *loc. cit.*; Herbst, *J. Am. M. Ass.*, May 23, 1908. Swinburne, *J. Am. M. Ass.*, January 26, 1907, and *Med. Rec.*, November 14, 1908.

CHAPTER LXXI

GONORRHEA: THE EXTRAGENITAL TYPES OF INOCULATION; THE SYSTEMIC MANIFESTATIONS

The gonococcus is specific to the human race. It is impossible to give gonorrhea to any animal.

The gonococcus may be inoculated readily in the eye, in the urethra of either sex, and in the female genital passages. The rectum is less vulnerable than the genitals. The mouth and nose are all but immune. The unbroken skin cannot be inoculated, and all squamous epithelium offers a marked resistance. Thus the urinary bladder, the preputial cavity of the male and the vagina of the adult female suffer rarely and, as a rule, mildly from gonorrhea, except in so far as they are involved in the contiguous inflammation of the urethra, the cervix, or the vulva.

That children are much more vulnerable to gonorrhea than adults is evidenced by the readiness with which little girls acquire vulvovaginitis, the frequency of gonorrheal conjunctivitis in children, and the fact that nasal and buccal gonorrhea occur almost, if not quite, exclusively in children.

EXTENSION OF THE DISEASE

Gonorrhea of the eye and rectum remain localized. In the genitals the disease extends by continuity as far as the vesical trigone, and throughout the genitalia of both man and woman.

The gonococcus penetrates the epithelium of the inflamed surface and excites exudation and subsequently sclerosis in the subjacent connective tissue; but it shows no great tendency to cause lesions to any depth except when shut in by inflammatory occlusion of the orifice of a gland. Under such circumstances it may cause abscess, invade the veins, forming thrombosis, and be carried to distant parts of the body, there to set up metastic gonorrheal foci.

By means of the blood stream gonococci may be carried to almost any organ. The favored locations for systemic gonorrhea are the joints and the iris. Less frequently it attacks the bursæ, the tendon sheaths, the pleura, the meninges, the periosteum, the parotid gland, the veins, the endocardium, the pericardium, the muscles.

Lymphatic absorption is uncommon and gonorrheal lymphangitis and lymphadenitis rare.

Absorption of gonorrheal toxins may affect the nervous system or the skin, producing erythema.

The peritoneum is involved in gonorrheal salpingitis, but gonorrheal peritonitis is extremely rare in the male. The kidneys are very rarely infected, and then possibly from the blood stream, though direct invasion from an infected bladder is not impossible.

ANORECTAL GONORRHEA

The anus is relatively immune to the gonococcus. Every acute vulvar gonorrhea pours pus over it, and yet, even in infants, it is not often inflamed. Jullien [1] has collected from the statistics of Howard, Schultz, and Baer, 1,037 cases of genital gonorrhea in women with 157 inoculations of the anus. Eichorn [2] noted 72 anal infections among 235 infected women.

Sodomy is the accepted cause for anal gonorrhea in men; but in women the infection is more often due either to direct inoculation by pus from the vulva or by indirect inoculation from the douche tube or the finger.

The lesions are both deep and chronic. The epithelium of the rectum is eroded, infiltrated, and in places ulcerated for several inches up from the anus.

Fissure and condyloma are common; the anus itself is infiltrated. Ischiorectal abscess and phlebitis of the hemorrhoidal veins have been noted as rare complications. Whether or not rectal gonorrhea is often a cause of stricture is not determined. The stricture is usually observed so late that its cause is not clear.

The symptoms are so slight that the condition is often overlooked. At the onset there is at most itching and burning. Later there are to all intents and purposes no subjective symptoms.

The lesion is rather rectal than anal. The anal orifice may be swollen; it is almost always fissured—"at six o'clock." A single moist, pointed, soft condyloma usually overhangs the fissure. There is often no external discharge, but a drop of pus may readily be expressed by pressure from the rectum. Proctoscopy reveals tumefaction, erosion, and ulcerated areas of the rectal mucosa.

Duration.—Rectal gonorrhea is extremely chronic. Jullien treated successive cases 116, 169, and 174 days before achieving a cure.

Diagnosis.—The gonococcus may be identified in the pus. If the condition of the genitals leaves any doubt as to the nature of the inflammation, the diagnosis should be verified by culture.

Treatment.—The rectum may be irrigated daily with potassium permanganate (1:200 to 1:25) or with mercurochrome (2 per cent to 10 per cent). Erosions and ulcers may be touched every second or third day with a nitrate of silver pencil.

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[1] *Le Blennorrhagie (formes rares et peu connues)*, Paris, 1906. Also Brunswickle Bihan, *Bull. Acad. de méd.*, Paris, 1907, lxxi, 497.

[2] *Dermat. Ztschr.*, 1909, xvi, No. 7.

BUCCAL AND NASAL GONORRHEA

That gonorrheal inflammation of the mouth and nose does occur in infants may be considered proven. But its existence in the adult is uncertain.

The existence of buccal gonorrhea in infants was proven by Ahlfeld.[3] Kimball [4] has reported eight cases of systemic gonorrhea in infants, one or more of whom were doubtless infected from the mouth. De Stella [5] has apparently proven the existence of infantile nasal gonorrhea.

In adults, however, we hear only of sporadic cases. The cases collected by Jullien fall under two heads, those in which urethral gonorrhea has been attributed to coitus *ab ore* (cases of Howard and Honnorat) and those in which stomatitis (cases of Cutler, Petit, Columbrine, Juergens, and four of Menard) or rhinitis (cases of Duncan (1784), Forcade, Edwards) are alleged to be gonorrheal.

The evidence against nasal gonorrhea in the adult is summed up in the experiments of Diday and Bormiere, who strove in vain to inoculate the nasal mucosa with gonorrheal pus. The clinical cases in favor are rare, ancient, and unconvincing.

Buccal gonorrhea is fortified by more modern instances. But the alleged gonococcus found may perfectly well have been the *meningococcus* or *micrococcus catarrhalis,* and the "intense" stomatitis is precisely what one would not expect.

A typical report is that "the stomatitis was intense, the gums ulcerated, the breath fetid. Bacteriologic examination revealed the gonococcus and the bacteria of Vincent's angina."

In this instance the stomatitis was doubtless a Vincent's angina, the "gonococcus" a *Micrococcus catarrhalis.*

In the infants the inflammation appears to be a severe one and confined, curiously enough, either to nose or mouth. In some instances nasal gonorrhea has accompanied ophthalmia neonatorum and has been attributed to infection through the lacrimal duct.

The duration of the inflammation is a few weeks, as a rule.

Antiseptic mouth wash and nasal spray effect a speedy cure.

SYSTEMIC GONORRHEA

The gonococcus invades the system through the blood stream. Its toxins may be absorbed by the same route. Though no one has disproven the participation of gonococcus toxins in the causation of the local lesions of systemic gonorrhea, the gonococcus has so frequently been found in the pus of joints and on the vegetations of heart valves and even in the blood, that such lesions are

[3] *Berl. klin. Wchnschr.,* October 19, 1896.
[4] *Med. Rec.,* 1903, lxiv, 761.
[5] *Deutsche med. Ztschr.,* 1899, No. 1.

attributed to the bacterium itself, leaving certain rare and manifestly toxic phenomena attributed to the toxin.

Toxic Lesions.—Skin lesions, neuroses

Bacterial Lesions.—Arthritis, osteo-arthritis.
Endocarditis, pericarditis
Bursitis, tenosynovitis
Periostitis, osteitis
Myositis, abscess
Iritis, systemic conjunctivitis
Phlebitis, thrombosis
Pleurisy, pneumonia, parotitis
Neuritis, meningitis (?)

Erythema and Neurosis.—Erythema, urticaria, pruritus, and various neuroses may occur during gonorrhea and may be relieved by cure of the gonorrhea.

The feeling of disgust, even amounting to neurasthenia, excited by "venereal" disease is, of course, purely psychic. Sexual neurasthenia is not peculiar to gonorrhea.

GONORRHEAL ARTHRITIS

Gonorrheal arthritis or gonorrheal rheumatism, as it is commonly called, is the commonest type of metastatic gonorrhea. It occurs in about 1 per cent of persons afflicted with urethral gonorrhea. Children are particularly prone to it, and may develop it from slight local lesions. Thus Kimball [6] found ten cases of gonorrheal arthritis among seventy children. Women are much less often affected than men, perhaps because they lack seminal vesicles. Northrup [7] reports 230 cases in the male to twenty-two in the female. It has been noted by Fournier as early as the fifth day after the onset of gonorrhea, but is commonest between the third and the fifth week. It may occur at any time while the patient harbors gonococci.

Etiology.—The occurrence of gonorrheal arthritis and indeed of all systemic gonorrhea, is subject to a curious law. The man who has once had gonorrheal arthritis will have a recurrence of this each time he contracts a fresh gonorrhea, unless this is immediately controlled. The first arthritis usually accompanies the first gonorrhea, though it may await the second attack and yet follow the rule thereafter. Moreover, no new joints will suffer in subsequent attacks that did not suffer in the first, with the exception that this rule is only regionally applicable to hands and feet; *e.g.*, metacarpus in one attack and carpus in the next. A fair minority give a history of previous injury to, or inflammation of, the afflicted joint. Vesiculectomy does not prevent recurrences.

From these considerations one may infer that, in many cases, seminal vesiculitis is perhaps not a cardinal cause; that indeed a predisposing lesion in the

[6] *Med. Rec.*, 1903, lxiv, 761.
[7] *Med. & Surg. Rep. Presbyterian Hosp.* (New York), 1896, i, 53.

joint rather than in the urethra is the chief difference between those gonorrheics who have rheumatism and those who have not.

Distribution.—The lesions are often polyarticular. Among Northrup's cases 76 per cent showed involvement of three or more joints. Moreover, synovitis, bursitis, and the other lesions of systemic gonorrhea are often associated with joint lesions.

The knee is the joint most frequently affected—two-thirds of Fournier's 120 cases, one-third of Finger's 375, seven-eighths of Bozeman's 278 cases.

Northrup's statistics show gonorrhea of the knee in ninety-one cases, of the ankle in fifty-seven, of the foot in forty, of the wrist in twenty-seven, of the head and toes in twenty-one, of the elbow in eighteen, of the hip and shoulder sixteen each, of the hand in eleven. The association of gonorrhea with spondylitis has been proved by Bouchard [8] and Chute.[9]

Pathology.—Gonorrheal arthritis like other types of septic arthritis, varies from a mere synovitis with periarthritis to an arthritis and osteo-arthritis. The last is uncommon, suppuration extremely rare. Indeed, among several hundred cases sent to my wards with the diagnosis of gonorrhea, no case of suppurative arthritis has proved to be gonococcic. Almost all of them were found to be tuberculous.

A noteworthy effect of arthritis is that it may keep up a positive complement fixation reaction for months after the urethral gonorrhea is well.

Clinical Types.—The onset may be acute or subacute. If acute, the inflammation begins like an attack of acute articular rheumatism, with pain, redness, swelling, tenderness and disability. But there are no sweats; the brilliant redness and exquisite sensitiveness of acute articular rheumatism are not seen, and fever is relatively slight.

A subacute onset varies in intensity from a mere ache with local tenderness to a moderately severe pain with some swelling and considerable disability.

The duration of the inflammation is characteristically prolonged. The mildest lesion may hang on for weeks and months.

Complications.—The complications due to direct extension from the joint are bursitis, tenosynovitis, and infiltrations of the surrounding tissues. Abscess outside the joint, as in the case reported by Ware,[10] is even rarer than suppurative arthritis. Implication of the bone is, as stated above, primary and not secondary.

The results of gonorrheal arthritis depend upon the treatment and the nature of the lesion. Osteo-arthritis may even result in total destruction of the joint with bony ankylosis. The worst that simple arthritis can do is to cause fibrous ankylosis. The most discouraging features of the prognosis are the marked tendency to chronicity, and the tendency to relapse after apparent cure.

Diagnosis.—Gonococcic arthritis occurs during acute gonorrhea or during an acute recurrence of gonorrhea. Yet I have seen acute gout and tuberculous

[8] *Ztschr. f. klin. Med.*, 1907, lxii.
[9] *Boston M. & S. J.*, 1904.
[10] *N. York M. J.*, January 13, 1906.

arthritis during an acute gonorrhea. The history of previous attacks may help in the diagnosis though the very fact of previous non-gonorrheal arthritis predisposes the joint to gonorrheal arthritis. The complement fixation test should be positive whether the joint is gonorrheal or not. Gonorrheal joints show a relatively marked para-articular infiltration as compared to other infections of like severity. Thus the appearance of the limb often suggests injury rather than arthritis. A suppurating "gonorrheal" arthritis I should suspect of tuberculosis and prove by radiography. Fever and sweats distinguish acute articular rheumatism.

Kimball has reported acute gonorrheal arthritis in children without genital gonorrhea.

Non-gonococcic septic arthritis, usually of a mild and very chronic type, may arise from chronic vesiculitis or prostatitis.

Prognosis.—Gonorrheal arthritis is spoken of as chronic but, though the infection is long drawn out, its actual chronicity is rather due to adhesions, infiltrations, exostoses and ankyloses than to actual chronic reabsorption of infection. Yet, so long as the gonococci are active, new joints may be, and not infrequently are, successively attacked. A badly infiltrated joint usually keeps a patient two months in bed and function is often fully restored for three to six months thereafter; but a severe case caught early may be well in two months.

Prophylaxis.—Efficient treatment of gonorrhea almost infallibly prevents arthritis. Only two of the many patients treated for gonorrhea in my private practice have developed arthritis.

Curative Treatment.—The patient must be put to bed to cure his arthritis and to prevent extension to other joints.

The urethral source of infection should be intelligently attacked.

The rage for vesiculectomy is apparently dying out. It is probable that this operation is commendable for the treatment of *chronic* arthritis, *not* due to the gonococcus, but attributable to the absorption of other bacteria or toxins from the vesicles. Such cases are characterized by chronicity and resistance to other forms of treatment. I have cured such cases by operation upon the vesicles quite as brilliantly as their fellows are cured by tonsillectomy. But vesiculectomy in my wards has failed to cure most cases of gonococcic rheumatism or even to disclose gonococci in the vesicles.

Vaccine treatment helps only in the first few days of the arthritis. I have had little luck with it, though I have used everything from horse serum to typhoid vaccine.

But *the real treatment for gonococci arthritis is immobilization.* Gonorrhea in a joint is just as self-limited, if given a chance, as it is anywhere else. At the first sign of arthritis the joint should be immobilized by a heavy plaster encasement. Nothing short of the heaviest, most extensive splint, if necessary, from head to ankle, will do. This, if properly applied, stops pain immediately; until it is applied the patient requires narcotics. (While it is on, the patient may be given a mild therapeutic x-ray treatment.) The cast is left on two weeks;

then removed for inspection, passive motion, massage, and baking. After two days it is replaced for another two weeks and so on, until the infection is controlled. Then orthopedic treatment is continued and the patient got about as rapidly as possible. Few escape with one application of the splint; most with two.

Exostosis of the Os Calcis.—Though first described by Baer, as recently as 1906, this condition is so common and so painful as to merit special mention. It begins as a myositis or periostitis at the attachment of the flexor brevis digitorum to the tubercle of the os calcis. With the subsidence of the acute inflammation an exostosis forms, pressure upon which in walking is exquisitely painful. The *diagnosis* is made by radiography. The *treatment* is operation. The exostosis must be chiseled or scraped away after exposure through an incision along the inner side of the heel. The scar left by the operation is sometimes as painful as the exostosis.

OTHER SYSTEMIC MANIFESTATIONS

The other manifestations in the list of systemic complications are many of them related to the joint lesions; others though not rare, such as involvement of the iris, are not conditions that the specialist finds himself called upon to treat. Indeed, the urologist should, whenever possible, turn over his joint cases for treatment by an orthopedist.

CHAPTER LXXII

GONORRHEAL URETHRITIS

Gonorrhea, or gonorrheal urethritis, is the most venereal of all venereal diseases, since it is the commonest malady acquired during the copulative act.

A most respectable antiquity is given to gonorrhea by the fifteenth chapter of Leviticus, although it is contended that the discharge known to the Jewish lawgiver was a simple urethritis, and that gonorrhea did not appear until later, according to Astruc in the year 1545-46.

ETIOLOGY

Gonorrheal urethritis is caused by implantation of the gonococcus upon the urethral mucous membrane. This implantation occurs almost exclusively in sexual contact. It is quite possible for the male to abstract outlying gonococci from the vulva of a timorous partner without effecting intromission. I have seen two instances of infection thus acquired. It is even possible to transmit gonococci to the urethra on the fingers. Less direct methods of contagion may be looked upon with suspicion. The mythical bathtub and the legendary privy are calculated to excite derision. However certain it be that vulvovaginitis in little girls commonly results from indirect contagion, and that infection of an adult from a drop of pus on the edge of the closet seat is perfectly possible, it is, nevertheless singular that such a mode of infection is alleged almost exclusively by persons who are interested in concealing a transgression.

Frequently enough our patient relates that his partner was "perfectly clean." Such "perfect cleanliness" is reducible to three heads:

1. Usually the woman is supposed to be exclusively attached to some one else, who marches about in apparent health. In this case all three of the parties are presumably gonorrheal, the suppliant acutely, the woman perhaps unconsciously, the accredited proprietor probably chronically. This explanation is founded upon the assumption that a woman may have gonorrhea and yet think herself clean, which is a matter of common knowledge, and that a man and woman, both infected, may cohabit habitually without exciting acute symptoms of gonorrhea in either. I have, for example, had two persons under my care, a woman (F.) and a man (M.), whose history may be summarized as follows:

Spring, 1908, F. infected with gonorrhea. Prompt "cure." November, 1908, F. leaves her paramour and attaches herself to M. M. promptly acquires gonor-

rhea. December, 1908, M. consults me. The woman is "perfectly clean." She has acute gonorrheal arthritis. I find gonococci in M. and in F. They continue to cohabit frequently. February, 1909, gonococci can no longer be found either in M. or F. There have been no further symptoms of gonorrhea in either. Local treatment has been employed by both.

2. Sometimes exposure is denied on the score that the male has worn a condom. In such a case the gonococcus has been acquired during preliminary skirmishing.

3. The most difficult case to explain is that in which the woman has been examined and pronounced clean by a physician. If the male actually harbors the gonococcus and has cohabited only with one woman, sufficiently careful examination of that woman by smear, culture and complement fixation will reveal the gonococcus.

That a woman may pass through an attack of acute gonorrhea and remain infectious, while never suspecting that she is diseased, is abundantly proven. That a male or female gonorrheic may cohabit with but one partner for many months before transmitting the infection is equally true. We scarcely need to add that of two men exposed to infection from one woman, one may acquire the disease, the other not.

PATHOLOGY

Urethral gonorrhea begins as an acute inflammation at the meatus, whence it travels inward along the urethral mucous membrane. Unless repressed by local treatment, this inflammation invariably travels as far as the bulbous urethra and usually invades the posterior urethra as well.

Pelouze [1] has called attention to the following established facts:

The gonococcus develops an endotoxin but no exotoxin. This is the product of bacteriolysis. If a solution of gonoccus endotoxin is injected into the urethra there is an inflammatory reaction in from four to twelve hours. The existence of urethral gonorrhea rather sensitizes the urethra to this toxic reaction to the solution.

The gonococcus grows readily in a mucous membrane covered with columnar or cuboidal epithelium. It rarely penetrates one lined with squamous cells. In the urethra it quickly reaches the columnar epithelium, finds its way into the intercellular spaces without entering the epithelial cells and penetrates (*a*) into the submucosa and at times into the corpus spongiosum and (*b*) into the crypts and glands. In the submucosa it forms minute colonies and as it completes its life cycle, sets free its endotoxin and so produces the tissue irritation that results in an exudation of serum and diapedesis of leukocytes. "Contrary to the idea generally held upon this question, the exuding fluids are evidently of greater value, in checking the inflammation than the phagocytic action of the leukocytes. . . . The leukocyte bears about the same relation to cure as the

[1] *Med. J. & Rec.*, Jan. 6, 1926.

refuse wagon does to the housekeeper; gets it off the premises but it is still the gonococcus."

The result of this inflammation is to loosen the attachments of the epithelia and diminish their nourishment. They are shed and replaced by other cells the more superficial of which tend to be squamous in type. Also, if the inflammation is prolonged and severe, nests of round-cell infiltration form within the mucosa and may even penetrate into the corpus spongiosum. "It is these infiltrations that later undergo fibrous tissue transformation and become the forerunners of stricture formation."

The process within the glands is the same as that upon the surface, but is characterized by stoppage of the gland ducts with detritus. This causes retention, chronic catarrh, abscess formation.

Injection of gonococci into the urethra causes no infection within forty-eight hours.[2] Hence such immediate reactions as the acute urethritis that follows the passage of a sound into the gonorrheal urethra, or immediate reactions in the prostate or epididymis are at first toxic rather than bacterial reactions. The subsidence of the urethral discharge at the onset of epididymitis is a direct reaction to the enormous increase in antibodies in the blood. These produce bacteriostasis but, as a rule, do not kill the gonococci in the urethra. After the subsidence of the epididymitis the urethritis resumes its activity.

"The pathological picture is quite complete and offers much argument against the generally accepted thought that we cure the disease by the direct bactericidal action of our various forms of treatment. It is obvious that the patient really cures his own gonorrhea and that we help only in so far as we encourage or stimulate his curative processes.

"The incubation period of urethral gonorrhea covers the period of transit, tissue penetration, luxuriant growth, germ destruction and the time required for the suppurative responses after the toxin liberation.

"A study of the time required for these responses shows that what we have called reinfections are merely the toxin responses of a sensitized mucous membrane. The time required for the evidences of re-infections is at least five times as great.

"The formation of tissue antisubstances is the body's chief means of curing the infection. This process is good where tissue drainage is at its best and almost nil where drainage is interfered with."

Pathology of Acute Anterior Urethritis

The most accurate data we possess in reference to the invasion of the urethral tissues by the gonococcus are those published by Finger, Gohn, and Schlagenhaufer, who inoculated the urethræ of condemned criminals, and were able, by means of immediate postmortem examination, to investigate the various stages of the invasion of the tissues by the specific microbe. Thirty-eight hours

[2] Finger, Gohn and Schlagenhaufer, *Arch. f. Dermat. u. Syph.*, 1894, xxviii, 276.

after inoculation the gonococci had only just begun to effect an entrance between the epithelial cells. The lacuna of Morgagni was crowded with the cocci, diapedesis had begun, and intracellular gonococci were found among the few leukocytes on the surface of the epithelium. At the end of three days the inflammatory process was well under way. The surface of the mucous membrane was covered with pus, its epithelium infiltrated by bacteria and by leukocytes. The inflammation showed four striking characteristics, viz.: (1) The pavement epithelium of the fossa navicularis, although swollen with leukocytes, resisted the invasion of the gonococci almost absolutely; (2) the cylindrical epithelium of the penile urethra was generally invaded; (3) this invasion was most marked about the crypts and glands, which were packed with pus and gonococci; and (4) the subepithelial connective tissue, though showing every evidence of inflammation, contained few gonococci, except in the neighborhood of the crypts and glands.

When the inflammation has reached its height the mucous membrane, from the tumefied meatus to the bulbous urethra, is intensely inflamed. Its surface is red and swollen, covered with pus and eroded or ulcerated. The epithelia and the subepithelial connective tissue are infiltrated by the warring gonococci and leukocytes.

The glands and crypts form the most important centers of inflammation. They are implicated in the general process; inflamed and distended with gonorrheal pus. The gland orifices become obstructed by the tumefaction of the mucous membrane and the glands thus form centers whence infiltration, and even suppuration, extends into the surrounding tissues. Since the glands are numerous and extend into the corpus spongiosum, the submucous infiltration, or suppuration, arising from them is often widespread and intense at the height of an acute gonorrhea, and leaves infiltrations that are the chief cause of chronic urethritis.

Were the urethra as glandless as the conjunctiva, urethral gonorrhea would show as little tendency to chronicity, complications, and systemic absorption as does conjunctival gonorrhea.

Pathology of Chronic Anterior Urethritis

As this acute inflammation subsides the tissues involved may return to a normal, or at least a clinically normal, condition, or the urethritis becomes chronic. The transformation of an acute gonorrheal anterior urethritis into a chronic condition implies certain pathologic and bacteriologic changes, as follows:

1. The surface of the mucous membrane is chronically inflamed. The inflammation may be localized over one or more small areas or may be general. The quality of the surface inflammation depends upon the degree of submucous sclerosis.

2. The inflammation within the glands and crypts persists as a chronic catarrh (glandular urethritis of Oberlaender), or the orifice of the gland is occluded and the inflamed gland becomes a purulent or colloidal cyst (dry urethritis of Oberlaender), or the gland frankly suppurates, or the glandular inflammation ceases either by cicatricial obliteration or by return to normal of the gland. These changes may all occur in the same urethra. The submucous glandular abscesses are minute and usually terminate by rupture within the urethra, exceptionally by invasion of the surrounding tissues and external rupture.

3. The inflammatory periglandular exudate becomes organized into cicatricial tissue of greater or lesser density and extent, according to the greater or lesser intensity and distribution of the acute inflammation.

If the sclerosis is slight the surface is swollen, red, and eroded in spots, while here and there appear the inflamed orifices of glands and crypts. The urethroscope shows increased redness, diminution of the number of urethral striæ and folds, and red, suppurating duct orifices. This is the *urethritis mucosæ,* the *soft infiltration* of Oberlaender.

More marked sclerosis causes a relative anemia of the overlying mucous membrane (after the redness of acute inflammation has disappeared), which is therefore salmon colored or grayish, lighter in color than the adjacent healthy mucosa. There may be spots of opalescent whiteness, where the chronically inflamed epithelium has been transformed from a columnar to a squamous type with tendency to leukoplakia; *i.e.,* heaping up of this squamous epithelium into thick "callous" masses. Elsewhere there may be erosions, ulcerations, papillary outgrowths. The urethroscope shows a pale rigid mucosa with striæ and folds almost or quite obliterated. Here and there one sees a white patch of squamous epithelium, red gland orifices, bleeding erosions, ulcers, or papillomata. This is the *hard infiltration* of Oberlaender.

Still more marked sclerosis causes urethral *stricture.* The processes mentioned in the preceding paragraph are intensified. The rigid urethral walls do not yield to admit urethral instruments. The caliber of the urethra is more or less diminished, perhaps almost completely occluded.

Hard infiltrations of greater or less degree are classified by Oberlaender as hard infiltrations of the first, second, or third degree. Hard infiltrations of the first degree do not encroach upon the urethral caliber. Those of the second degree diminish the caliber of the urethra to such an extent that large instruments [3] can still be introduced, but only at the expense of more or less laceration of the epithelium.[4] Those of the third degree do not admit large instruments until after they have been dilated.

These more or less arbitrary subdivisions correspond to clinical types of urethritis. Yet it must not be forgotten that they are but degrees of the same

[3] Oberlaender makes a urethroscopic tube of 23 F. size the criterion.

[4] This is the "stricture of large caliber" of the elder Otis.

process. Therefore, while the mildest form of chronic urethritis may exist alone, the more intense "hard" infiltrations are at first always accompanied by more diffuse "soft" infiltrations which may for a time conceal them.

The soft infiltration may heal spontaneously; the hard infiltration requires treatment by dilatation, and leaves a permanent scar in the walls of the canal.

4. As the inflammation becomes chronic, other bacteria replace the gonococcus.

Pathology of Posterior Urethritis

The pathologic changes produced by gonorrhea in the posterior urethra are essentially the same as those produced in the anterior urethra. But certain anatomical differences vary the actual conditions. These are:

In the membranous urethra—
- The relative rarity of glands.

In the prostatic urethra—
- The complexity of the glands immediately beneath the mucous membrane.
- The verumontanum and utricle.
- The great complexity of the internal sexual glands (prostate, vesicles) emptying into the posterior urethra.

In the trigone—
- The rarity and simplicity of glands.

The glands of the membranous urethra are relatively few and simple. Hence, chronic gonorrhea of the membranous urethra is clinically mild and is overshadowed by the inflammation of other portions of the canal. Submucous infiltrates are usually slight. Stricture is rare, chronic glandular catarrh usually mild.

The relatively large and complex glands of the prostatic urethra, and the utricle, form nests for abscess formation and subsequent catarrh, in which the gross retention of pus preponderates over the sclerosis.

These abscesses are larger than those commonly formed in the glands of the anterior urethra. They excite fever and burst into the canal with a recognizable outpouring of pus.

Chronic Posterior Urethritis.—The urethral mucosa undergoes much the same changes as those of chronic anterior urethritis. But as the inflammation grows less it may become localized in certain special forms as follows:

Villosities, improperly termed papillomata,[5] may persist in various parts of the posterior urethra. They are exuberant granulations arising from a small ulcer.

Follicular abscesses and cysts are rare. They usually occur beyond the verumontanum.

[5] *Surg., Gynec. & Obst.*, 1913, xvii, 548.

Verumontanitis.—The verumontanum may be regarded pathologically as a hood covering the utricle. Hence a chronically inflamed verumontanum is always associated with utriculitis, usually with vesiculitis. The urethroscope shows a swollen, red verumontanum, perhaps much hypertrophied and covered with granulations. Irrigation of the utricle usually discloses pus in its cavity; amputation of the verumontanum (Rytina [6]) shows submucous and periacinous round cell infiltration.

[6] *J. Am. M. Ass.*, 1915, lxiv, 45.

CHAPTER LXXIII

SYMPTOMS, COURSE, AND COMPLICATIONS OF URETHRAL GONORRHEA

Since acute gonorrhea of the male urethra always begins with inflammation of the balanitic urethra,[1] continues by direct extension of the inflammation along the urethral mucous membrane, and may terminate before the inflammation reaches the posterior urethra, to be accurate we should speak of anterior urethritis alone as essential gonorrheal urethritis and class all other gonorrheal inflammations, including posterior urethritis, as complications. But in as much as the average uncontrolled urethral gonorrhea invades the posterior urethra, the trigone, and the prostate, it is clinically convenient to group anterior urethritis, posterior urethritis, and prostatitis in the type description of the disease and to follow with a description of other inflammations as complications. Accordingly, we shall describe:

The incubation
Typical acute gonorrheal urethritis
Complications of acute anterior urethritis
- Abscess of the urethral glands
- Periurethritis and periurethral abscess
- Inflammation of the erectile tissues
- Balanoposthitis, lymphangitis, lymphadenitis

Complications of acute posterior urethritis
- Prostatitis
- Prostatic abscess
- Seminal vesiculitis and deferentitis
- Epididymitis
- Cystitis
- Pyelonephritis
- Peritonitis

INCUBATION OF GONORRHEAL URETHRITIS

The incubation period of gonorrhea varies from two to seven days. Yet I confess to some suspicion of inaccuracy in reference to those cases on the

[1] Excepting cases of reinfection of the urethra from gonococci that have lain quiescent in the urethral glands, which cases are properly classed as relapses.

subjoined list that give a story of more than a week's incubation. Perhaps some of them had very long foreskins.

Prophylactic injection, if it fails to prevent gonorrhea, may considerably prolong the period of incubation, perhaps up to fourteen days.

Experimental inoculation produces a discharge on the second, third, fourth, or fifth day; but it has been my experience that the shorter incubations are clinically due to the association of sexual strain or of simple urethritis with the gonococcus. Such a condition may be expected to occur most often in the damaged urethra; hence the relatively large number of short incubations among recurrences as compared with first attacks.

LENGTH OF INCUBATION *

Day	First Attack, Cases	Recurrence, Cases
1	0	2
2	2	12
3	2	15
4	3	13
5	11	10
6	6	4
7	4	10
8	1	2
9	1	1
10	1	4
11	1	1
12	1	0
13	1	0
14	0	2
TOTAL	34	76

Average incubation of 34 primary attacks, 6 days.

Average incubation of 76 secondary attacks, 4.88 days.

Of the primary attacks, 20 per cent appeared before the fifth day; 61 per cent on the fifth, sixth, and seventh.

Of the secondary attacks, 55 per cent appeared before the fifth day; 31 per cent on the fifth, sixth, and seventh.

* I have included in this list only those cases in which the incubation period was unmistakable and the disease absolutely characteristic.

TYPICAL ACUTE GONORRHEAL URETHRITIS

Onset.—A tickling, teasing, itchy irritation is felt at the orifice of the urethra. The lips of the meatus are found adherent, or a bluish, sticky discharge is seen between them. A slight stinging is felt on urination. The lips of the meatus now swell slightly and redden. The quantity of discharge increases and it becomes frankly purulent. The meatus feels hot and sore. The pain on urination increases.

Height.—In a period varying from a few hours to two or three days the inflammation reaches its height at the meatus and has invaded the greater part

of the anterior urethra. The symptoms of anterior urethritis are swelling of the meatus, purulent discharge, painful urination, and painful erections.

The Swollen Meatus.—The lips of the meatus are red, swollen, everted, sometimes eroded. Their tumefaction begins with the disease and usually subsides during the second or third week, long before the subsidence of the inflammation of the deeper portion of the urethra. It is less constant and less marked with secondary than with primary attacks.

The Discharge.—The drop of thick greenish-yellow pus constantly exuding from the swollen meatus completes the outward picture of acute gonorrhea. Blood may appear in the discharge from time to time. The pus ceases to be thick and creamy some time after the swelling of the meatus has subsided. It becomes less in quantity and more watery and opalescent in quality as the acute inflammation of the anterior urethra declines.

The Pain on Urination.—The urethral mucous membrane is swollen, sensitive, and eroded. Hence, the passage of urine is painful, the stream slow and obstructed.

The pain due to anterior urethritis reaches its height within ten to fourteen days and begins to subside between the fourteenth and the twenty-fifth day.

The Painful Erections.—The urethral inflammation encourages nocturnal erections. The inflamed membrane is relatively inelastic, hence these erections are exceedingly painful The inflamed surface may be so cracked and fissured that it bleeds copiously. Since the corpora cavernosa retain their normal distensibility, the inelastic, inflamed urethra is pulled taut beneath them when the penis is erect, so that in severe cases the organ is bent downward, while the pain is excruciating. This phenomenon is called *chordee.*

Painful erections may continue for days after the surface of the anterior urethra has ceased to be sensitive to the passage of urine.

Invasion of the Posterior Urethra and Prostate.—It is clinically impossible to distinguish acute posterior urethritis from acute prostatitis, and although in some instances the posterior urethra is involved and the prostate apparently spared, this cannot be determined until after the disease has become chronic.

The frequency of posterior urethritis in acute gonorrhea is estimated variously. Van der Poel estimates it at 60 per cent, Wassidlo quotes various authors at from 86 per cent to 92 per cent. Prostatitis is estimated to complicate about 70 per cent to 80 per cent of acute posterior urethritis, though Columbini places it as low as 36 per cent.

The confusion in these figures is due to the various means of examination employed. Subjective symptoms of posterior urethritis are excited by the majority of initial gonorrheas, are less common in subsequent attacks, and are rare in office patients treated by repressive measures. On the other hand, if pus in the second flow of urine is taken as a criterion, the percentages run much higher. Let us be satisfied to say that acute posterior urethritis is extremely common and usually associated with prostatitis.

Posterior urethritis usually appears between the fifth and the fifteenth days of acute gonorrhea.

Symptomless Cases.—The figures given in the preceding paragraphs illustrate the frequency with which gonorrhea invades the posterior urethra without causing subjective symptoms.

The evidence of this invasion is pus in the second flow of urine or pus in the prostatic secretion.

It is probable that in these symptomless cases the prostatic urethra is only mildly inflamed, the trigone spared altogether.

Symptoms of Acute Posterior Urethritis and Trigonitis (Cystitis).—The symptoms of acute gonorrheal posterior urethritis, trigonitis, or cystitis are all referable to the irritation at the bladder neck. This causes frequent and urgent urination, painful urination, and terminal hematuria.

Frequent and Urgent Urination.—So long as the pain of urination is due solely to anterior urethritis the patient urinates as rarely as possible. When it is due to posterior urethritis he *must* urinate frequently. As soon as a relatively small amount of urine has collected in the bladder an urgent call to urinate is felt; a call that will not be denied. If the victim does not quickly acquiesce he irrigates his trouser leg. The frequency of this urgent call may be so great that the patient dribbles away a few drops of purulent urine every ten or fifteen minutes night and day. A frequency of less than once in two hours may be accounted mild.

Painful Urination.—The pain of posterior urethritis is more constant than that of anterior urethritis, and is often referred to some point on the surface of the body, usually the perineum, the anterior urethra just back of the glans, or the epigastrium.

The pain at urination in posterior urethritis has several striking characteristics. It appears before urination, as we have just seen, in the form of urgency. During urination the posterior urethra can be more exquisitely sensitive than the anterior urethra. But it is at the end of urination that the full force of this pain is felt. As the muscles of bladder and urethra contract to expel the last drops of urine the inflamed surface is violently wrenched. The resultant pain, like that of anal fissure, is a spasm or series of spasms that may last for many seconds after the bladder has emptied itself. In severe cases the patient may be said to pass from one terminal urinary spasm to another.

Terminal Hematuria.—The intensity of the inflammation, together with the incessant trauma of the frequent urination, often excite bleeding from the posterior urethra. This bleeding may be constant or intermittent. In either case the amount of blood lost is not great, and the three-glass test reveals terminal hematuria; *i.e.,* whether the body of the urine be bloody or not, the last jet is almost pure blood. Terminal hematuria is caused by terminal spasm.

The Decline.—The inflammation subsides first where it first began, *i.e.,* at the meatus. The meatal inflammation often disappears in the second or third

week, while the inflammation is elsewhere at its height. In the rest of the anterior urethra the inflammation usually begins to decline in the third or fourth week; the discharge becomes thinner and more watery, the erections less painful. The pain, frequency, and bleeding that mark posterior urethritis may begin to diminish at almost the same time.

In the fourth or fifth week the patient's symptoms are reduced to a semi-purulent discharge, which grows less and less in quantity. From the sixth to the eighth week this discharge usually continues almost or quite exclusively as "a morning drop," a drop of pus appearing at the meatus only before the first morning urination; during the rest of the day the urethra is apparently clean. Now the patient fancies himself well. But examination of the urine still reveals pus; examination of this pus still reveals gonococci.

It is rare for the gonococci and pus to disappear within six weeks. It is common for them to persist eight to twelve weeks.

By common consent the gonorrheal urethritis of less than two months' duration is called acute, of more than three months' duration chronic. The division is purely arbitrary, but it voices the fact that acute gonorrhea is often cured in from eight to twelve weeks.

The good or evil fortune of the patient in his choice of a physician as well as in his reaction to the disease so influences the course of each individual case of gonorrhea that the attempt to separate "typical" from "atypical" cases, though justified by expediency, has no foundation in clinical fact. The above description of a "typical acute gonorrheal urethritis" describes many cases in general but none in particular. Every case is actually "atypical" to a greater or less degree.

Prolonged or Complicated Cases.—What proportion of gonorrheics become chronic I do not know. In the clinic most cases approach the three-months' limit and perhaps half surpass it. In private practice, by the aid of repressive measures, we get better results.

But practically every unrepressed case of gonorrhea is a "complicated" case. Some one of the complications mentioned below almost invariably arises unless repressive measures are successful.

Cases Modified by Treatment.—The local treatment now almost universally employed throughout acute gonorrhea always materially modifies the course of the disease. If successful it ameliorates all the symptoms and minimizes the danger of complications; if unsuccessful, it intensifies the urethral inflammation, excites complications and encourages chronicity.

COMPLICATIONS OF ACUTE ANTERIOR URETHRITIS

Abscess of the Urethral Glands.—Minute abscesses due to obstruction of the ducts of suppurating glands doubtless occur and pass unnoticed amidst the intense symptoms of every acute urethral gonorrhea. Such abscesses occurring during the declining stage cause a characteristic brief explosion of acute symp-

toms. After a day or more of vague localized uneasiness or itching a sharp reinfection of the urethra occurs. The discharge becomes profuse and creamy; the meatus may even swell, but there is usually no pain. But no sooner has the patient decided that he must look forward to weeks more of suffering than the discharge abates almost as suddenly as it appeared.

This sudden abatement of discharge is doubtless due to local immunity persisting from the preceding acute urethritis. It is exceptional for this immunity to be so slight as to permit prolonged relapse.

Periurethritis and Periurethral Abscess.—Abscesses arising from the balantic portion of the canal appear at one or both sides of the preputial frenum. They grow rapidly and, having opened or been incised, often leave permanent fistulæ requiring operation for their cure.

Abscess of the pendulous urethra usually projects from the floor of the canal as a hard nodule. It may grow quite slowly and may resolve or break into the urethra. But it is far more likely to discharge externally.

Abscess of Cowper's gland may cause only a temporary nodule beneath and lateral to the membranous urethra. The suppuration is usually discovered after it has extended forward, following the duct, to surround the bulb. Here Buck's fascia is likely to confine it until it reaches the penoscrotal angle where it will break through the fascia and skin. It may also discharge in the perineum. But perineal suppuration is usually from the prostate.

Inflammation of the Erectile Tissues.—*Spongeitis* and *cavernitis* are extremely rare complications of gonorrhea, if we except that type of the former that manifests itself in chordee.

Thrombophlebitis of the erectile tissues or inflammation of the fibrous envelopes manifest themselves as sensitive indurations of the erectile bodies. They usually resolve without suppuration.

Balanoposthitis.—The gonorrheic with a long or tight foreskin usually develops balanoposthitis. Yet the complication is rarely severe. It is apparently due to mixed infection.

Lymphangitis and Lymphadenitis.—These complications are rare, excepting in the army. The soldier on service has small opportunity to keep his preputial cavity clean. Hence the balanitis. They result usually from balanitis, less often from periurethritis, and, like the balanitis of gonorrhea, are rarely severe. I have seen but one gonorrheal bubo that required incision.

COMPLICATIONS OF ACUTE POSTERIOR URETHRITIS

Prostatic Abscess.—In drawing an arbitrary division between acute prostatitis and prostatic abscess, it is wiser to include with the latter all cases of acute prostatitis of sufficient severity to cause symptoms. This for two reasons: all such cases do represent retention of pus within the prostate ducts, and any one of them may progress to unmistakable abscess formation.

To attempt to draw the line between the prostate in which macroscopic sup-

puration, as an abscess, has already occurred, and that in which it only threatens, is impracticable.

Symptoms.—The symptoms of prostatic abscess follow one of three types, as follows:

The *local symptoms are accentuated.* To the pain and frequency of urination due to posterior urethritis is added a constant dull or throbbing ache inside the pelvis, which may or may not radiate to the urethra, the testicles, the thighs, the hypogastrium, or the loin. If the prostate is much enlarged defecation is apt to be both painful and difficult.

Fever is remarkable rather by its absence than its presence. Doubtless a slight febrile reaction characterizes the onset, but this may escape observation. When fever does occur, even though the temperature rises abruptly enough to occasion a chill, the fever in most instances promptly subsides almost or quite to normal even while the painful or obstructive symptoms are on the increase. Thus during the height of its activity *absence of fever is characteristic of prostatic abscess.*

Retention of urine, usually complete and requiring relief by the catheter, may be the dominating symptom. It is due to the swelling of the gland and may or may not be associated with frequency of urination.

The suppurating prostate is always enlarged, usually sensitive. The whole of one or both lobes is involved. The diagnosis should be made long before either boggy softening or fluctuation shows that the whole of a lobe has been transformed into an abscess cavity.

The process may terminate by resolution; by rupture into the periprostatic tissue, causing periprostatic abscess, or into the urethra, or by passing on to chronic prostatitis.

The periprostatic abscess rarely resolves. If not drained it usually reaches the perineum in front or to one side of the anus, where it is distinguishable, at operation, from abscesses of Cowper's gland by its position superficial to the deep fascia (of Buck). Hence periprostatic abscess does not run forward along the urethra, but if neglected may extend from the perineum to the scrotum, to the groins, and thence above the pubes and to the loins in the subcutaneous connective tissue. In other instances the extension of the suppuration is cut short by spontaneous rupture into the rectum. Extension upward into the pelvis and rupture into the peritoneum are rare.

Seminal Vesiculitis.—Acute seminal vesiculitis, like acute prostatitis, usually gives no sign of its presence. If suppuration occurs in the vesicle the symptoms are those of prostatic suppuration, but a finger in the rectum discloses a tense, sausagelike tumor in the region of the inflamed vesicle. It usually terminates in resolution, but may rupture into the ischiorectal fossa, the rectum, or the peritoneum. Pericystitis due to gonococci and arising from a focus in prostate or vesicle may be expected to subside.

Vesiculitis does not occur without prostatitis. It is impossible to differentiate inflammation of the ampulla of the vas from vesiculitis.

Cystitis.—The familiar gonorrheal trigonitis already described implies some inflammation of the rest of the bladder, but this is not a clinical feature of gonorrhea.

Pyelonephritis.—This is an extremely rare complication of gonorrhea. It is described in connection with other types of pyelonephritis.

Peritonitis.—Pelvic peritonitis is as rare a complication of gonorrhea in the male as it is common in the female. Battey [2] has collected thirty cases. Thomas [3] reports two more. The inflammation is due to vesiculitis or deferentitis. Its symptoms are the classic ones of pelvic peritonitis.

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[2] *Thèse de Lyon*, 1901; *Brit. M. J.*, April 5, 1902.
[3] *Northwestern Med.*, February, 1907.

CHAPTER LXXIV

CHRONIC URETHRAL GONORRHEA

Chronic gonorrhea is gonorrhea lasting more than three months. The term is arbitrary and by no means strictly accurate, for chronic gonorrhea may be interrupted by acute relapses of the diseases without thereby ceasing to be chronic.

Gonorrhea becomes chronic because the urethral lesions caused by the gonococcus persist. These lesions may harbor the gonococcus alone, or in connection with other bacteria, or simply other bacteria without the gonococcus. They may involve the anterior or the posterior urethra or both. Chronic gonorrhea is therefore to be subdivided as gonococcic and postgonococcic and as chronic anterior urethritis and chronic posterior urethritis.

Gonococcic chronic urethritis is distinguished clinically by a tendency to be more severe, to relapse more viciously, to resent the trauma of instrumentation and alcohol more sharply than does non-gonococcic urethritis. Yet these clinical distinctions are both vague and relative. They have meaning only to the expert. A specific urethritis may be latent for months, a non-specific one may be peculiarly virulent.

To distinguish the symptoms of chronic anterior urethritis from those of chronic posterior urethritis is a necessity, but clinically the two usually exist together, the one or the other predominating.

Chronic Prostatitis.—We may group all cases of chronic prostatitis, whether gonorrheal or not, under one head.

"In our series of 358 cases, no etiology was obtained in 53 cases (14.8 per cent); there was a history of gonorrheal urethritis in 262 (73.2 per cent); of masturbation in 27 (7.5 per cent); of prolonged sexual excitement (without coitus) in 4 cases and withdrawal in 3 cases (2 per cent); of descending infection in 3 (0.8 per cent); of traumatism (bicycling twice) in 3 (0.8 per cent); of instrumentation in 2 (0.6 per cent); of infectious diseases (grippe) in 1 case (0.3 per cent). When gonorrhea had existed, that was accepted as the cause of the prostatitis, although in some of these cases abnormal sexual practices may have played an important rôle" (Young, Geraghty, and Stevens).

The symptoms have been described in Chapter XX.

SYMPTOMS AND COURSE OF CHRONIC ANTERIOR URETHRITIS

The one subjective symptom of chronic anterior urethritis is a *urethral discharge,* greater or less in quantity, purulent, semipurulent, or sticky and mucoidal.

Sensations of itching or pain almost invariably arise from posterior urethritis and its complications, even when the sensation appears to be situated in the anterior urethra.

But, since this urethral discharge is but the evidence of an overflow of pus, the flow may be intermittent and months, even years, may elapse while an interior urethritis continues but gives no outward sign; but produces only a little pus or a few shreds in the urine.

The *course* of a chronic anterior urethritis may be interrupted by outbreaks of acute infection, either a relapse or a new gonorrheal infection. Such outbreaks are usually much less severe than the initial attack.

The great *complication* of chronic anterior urethritis is urethral stricture.

Abscess of the urethral glands may remain as little suppurating pouches. These may (1) simply maintain the infection, or (2) be palpable as shotty indurations, which (3) may at any time become acutely inflamed and tender and even (4) set up periurethral abscess.

SYMPTOMS OF CHRONIC POSTERIOR URETHRITIS AND PROSTATITIS

Chronic posterior urethritis and chronic prostatitis can rarely be distinguished from each other. Indeed, chronic posterior urethritis implies chronic prostatitis. On the other hand, chronic prostatitis may not be complicated by chronic urethritis [1] (30 per cent of 280 cases studied by Young).

Hence it is preferable to consider chronic posterior urethritis under the title of chronic prostatitis.

The symptoms of chronic prostatitis are much the same whether caused by the gonococcus or not. If gonococcic, the inflammation is more likely, either spontaneously or as the result of massage or urethral instrumentation, to light up an acute urethritis, while non-gonococcic (or postgonococcic) cases sometimes flare up in the shape of vesical bacteriuria.

[1] *I. e.*, the prostate may contain pus but the urine be free from pus and shreds.

CHAPTER LXXV

DIAGNOSIS OF GONORRHEAL URETHRITIS

THERE are two essential features in the diagnosis of urethral gonorrhea. We must distinguish both the presence or absence of the gonococcus and the distribution of the urethral lesions.

Diagnosis of the gonococcus:

Differentiation between simple urethritis and gonorrhea

Discovery of the gonococcus in chronic urethritis

Diagnosis of the seat of the lesion:

In acute urethritis

In chronic urethritis

Urethroscopic diagnosis

DIAGNOSIS OF THE GONOCOCCUS

Acute Simple Urethritis and Gonorrhea.—When a patient presents himself complaining of having contracted a gonorrhea, an inspection of his penis will often confirm or refute this opinion. If the lips of the meatus are red and swollen, exuding a creamy discharge, there can scarcely be a doubt of the specific nature of the infection. But *an examination of the discharge is necessary to differentiate true gonorrhea from simple urethritis.* It may be that the gonorrheal inflammation is not yet well under way, or that there is chronic gonorrhea, of which this is an exacerbation, or, on the other hand, the whole matter may be a mere simple urethritis. In each case the discharge may be slight or profuse, watery or creamy. The microscope and "the Gram" are required for an immediate decision and to afford the patient the advantages of immediate local treatment.

I fear not every one will accept the statement that non-gonorrheal urethritis can simulate the true specific inflammation; but I have seen a few cases that went through a very fierce attack and proved exceptionally unmanageable, although the patients denied any sexual act for many weeks before the beginning of their attacks, while repeated microscopical examinations revealed no gonococcus in the discharge. In other cases the acuteness of the onset gave every promise of a true gonorrhea, but the negative microscopic evidence was confirmed by the rapid subsidence of the inflammation under a course of treatment that never could have conquered the gonococcus.

Discovery of the Gonococcus in Chronic Urethritis.—"May I get married?" The frequency with which the sufferer from gonorrhea presents him-

self with this question on his lips is a sad commentary upon the levity of youth. Yet it is a question which the practitioner is frequently—nay, commonly—called upon to answer. And upon the correctness of that answer the happiness of a household often depends. An error on the side of overcaution—forbidding a man to marry when he has a perfect right to do so—is only less heinous from the patient's point of view than the permission to marry before the danger of infection has passed. On the one hand there is the prospect of moral despair for both parties, on the other the certainty of infection of the innocent with all its train of physical woes and the possible discovery of the guilty partner, with results that need not be dwelt upon here.

And unhappily, the question is not an easy one to answer. So difficult is it, indeed, that scarcely any two authorities agree as to the criteria upon which the answer shall be based. Against the general vagueness of the light-hearted practitioner, himself a *roué,* who proclaims that one is free from danger as soon as he is down to his customary morning drop, we may oppose the Spartan severity of those few authorities who assert that once a gonorrheic always a gonorrheic, once infected always infectious.

The broad-minded adviser will avoid either extreme. He knows that the majority of men who have had gonorrhea become and remain absolutely sound and clean. He recognizes also, that while most of those who exhibit the traditional morning drop are undoubtedly infectious, there remains an important minority even of these that cannot impart its disease, under whatever stress of sexual excitement. These are practical commonplace facts. We need not concern ourselves with those rare cases of alleged marital infection ten or twenty years after a cured gonorrhea. By their very nature such cases are open to a suspicion of that symptom common to all venereal disease, viz., lying, and against them I can advance the experience of thirty-five years, during which countless patients have been advised to marry by my father and myself with but three errors so far as I know. (And all will recognize the probability that such an error would rebound forcibly enough upon its perpetrator.) Such being the case, I am willing to assert the possibility of determining the presence of gonococci in any given urethra.

When does the gonorrheic patient cease to be in danger of infecting the woman with whom he cohabits? Not until the gonococci have been entirely eliminated from him. The gonococcus is the sole infectious agent. If it is present, there is danger; if not, there is none. But to find the gonococcus is no easy matter. Its presence may be *suspected* on account of the symptoms the patient presents or it may be *proved* by the evidence which bacteriology has provided.

The notable clinical evidence of the presence of gonococci is pus, and in view of the prevalence of gonorrhea it is a general rule that *whenever there is pus anywhere in the genital or the urinary tract the presence of gonococci may be suspected, and conversely when the whole tract is proved free from pus the*

presence of gonococci may be denied (with the single exception that the patient may have just been infected and may still be in the incubation period).

Clinically speaking, a great many cases may be ruled out at once. Thus, gonorrhea of the kidney is very rare and never occurs except in conjunction with gonorrhea of the lower urinary passages. Similarly the history of suppuration due to prostatism, stone, tubercle, or tumor is usually such as to rule out gonorrhea. The cases that come for diagnosis may be divided into three classes:

Those who, having had gonorrhea, continue to have pus in the urine or are subject to relapses of pyuria or urethral discharge.

Those who, having had gonorrhea, whether they allege a continuance of the discharge or not, are not subject to acute relapses, no matter how much sexual and alcoholic dissipation they indulge in.

Those who, after a gonorrhea, have no longer a discharge or any other symptom, show perfectly sparkling urine and from whose prostates and vesicles no pus can be expressed.

Of the first class the majority are still infectious; of the second class the majority are no longer infectious, while all who continue in the third class for a month are certainly free from gonococci. For these last, then, the clinical diagnosis suffices; for the others there is only a probability from which the experienced physician may often reach an assured conclusion one way or another, but a probability which always requires to be confirmed by scientific tests.

Most important of all, the only dependable laboratory test for the presence of gonococci is culture. But laboratory culture is beset with difficulties and by no means universally accessible. However, the patient's own urethra presents a culture-medium, not quite ideal it is true, for it has acquired at least a partial immunity; but it will serve. If there are gonococci in the urethral glands, let them be traumatized. With the patient's blood-serum as culture-medium, with the traumatized tissue as their forcing bed, these gonococci will set up a fresh infection, an acute urethritis, in which the microscope will find cells crowded with Gram-negative intracellular diplococci.

Urethral culture of gonococci is the most unmistakable evidence of their presence.

How to apply the trauma is the practical question. In Chapter LXXVI will be found a description of the way this axiom of the reaction of gonococci to trauma is made use of to hasten the decline of a controlled gonorrhea by the use of sounds. If there is any prostatic or vesicular suppuration, massage of the prostate and vesicles should be employed, to excite mild acute infection if gonococci are present. If the diagnosis of the urethral lesion calls for the urethroscope, this may be employed as the traumatizing instrument instead of a sound.

Laboratory Evidence.—The laboratory evidence of the presence of gonococci is threefold: (1) Smear; (2) culture; (3) fixation test.

1. The Gram-stained smear of a profuse urethral discharge gives the expert technician reliable evidence of the presence of gonococci, though their absence from a given smear does not prove them absent from the urethra.

In acute urethritis, therefore, a positive smear is reliable.

But in chronic urethritis even a smear pronounced positive by an expert is not in itself in the least reliable. The Gram-negative cocci may be staphylococci. The test of trauma gives far sounder clinical assurance.

The mere presence of Gram-negative intracellular diplococci in pus obtained from a mildly or chronically inflamed urethra does not warrant the diagnosis of gonorrhea.

2. *Culture, if positive, is infallible.* Negative laboratory culture tells us nothing of clinical significance. And, unfortunately, the difficulty of getting a good specimen to the laboratory, added to the laboratory difficulties of culture itself, put this means of diagnosis out of the reach of many practitioners, and make it for all of secondary and merely confirmatory value as compared to the urethral-trauma culture test.

3. The complement fixation test for gonorrhea is subject to variation, even at the hands of the best technicians. Strongly positive reactions are occasionally obtained with the blood of persons who have no longer a trace of gonorrhea. The observations on page 669 are true, but the findings are not wholly reliable. The gonococcus fixation test of to-day has about the same accuracy as the Wassermann test of fifteen years ago.

In short, I now depend for the diagnosis of cure of infectiousness upon the clinical evidence and the trauma test, confirming these always by smears studied in my own laboratory and seen by myself. Laboratory culture I employ only exceptionally. But I always check results with the fixation test. If it is positive the patient may be infectious even though all other signs are negative. Each urologist must be familiar with the fixation test as performed by his technician.

DIAGNOSIS OF THE SEAT OF THE LESION

Acute non-gonorrheal urethritis may originate either in the anterior or the posterior urethra. The diagnosis of its origin and extent is conducted precisely as is that of chronic urethritis.

Acute gonorrheal urethritis always begins in the anterior urethra. The pouting meatus and creamy discharge amply attest the presence of anterior urethritis. But to diagnose the presence of acute posterior urethritis is not always possible.

If both the first and second flows of urine are cloudy there is posterior urethritis.

If only the first flow is cloudy, there may be posterior urethritis. This is negligible for the time, but may cause trouble later by delaying the cure. In other words, the mere fact that throughout a carefully observed gonorrhea the

second urine has always been clear by no means eliminates posterior urethritis, and in the event of such a urethritis becoming chronic the posterior urethra must not be neglected.

Examination and massage of the prostate reveal lesions in that organ as in chronic urethritis; but if the infection is acute this examination should be postponed.

Diagnosis of the Distribution of Chronic Urethritis

Since it is not my custom to use the urethroscope in the diagnosis of gonorrhea except in rebellious and protracted cases, I prefer to describe the routine method of examination followed at the patient's first visit, leaving the matter of urethroscopic diagnosis for subsequent discussion.

Upon accurate diagnosis depends the patient's prospect of cure, and such diagnosis, even without urethroscopy, may require several examinations.

The patient presents himself with a history of chronic or relapsing urethral discharge, with shreds or pus in the urine, or with various sexual or painful symptoms.

The First Examination.—The examination for gonococci already described takes first place. The routine examination of the lesion is as follows:

1. The meatus is examined for discharge (and a smear taken for microscopic examination) and inflammation, the urethra for nodules of periurethral infiltration, the testicles for evidence of epididymitis.

2. The patient then urinates in two glasses, as described in Chapter II.

3. A 16 F. catheter is introduced, the site of pain, bleeding or obstruction noted, residual urine estimated (to be confirmed by subsequent examination), and about 100 c.c. of 1:5,000 acriflavin solution injected into the bladder.

4. Prostate and vesicles are then massaged; any expressed secretion is caught upon a slide for examination.

5. The patient then empties the bladder into two glasses, if no secretion has been expressed by massage; otherwise into one.

From this examination we glean the following diagnostic points:

Anterior Urethritis.—Usually pus at meatus. Second flow of urine clear. No abnormality felt in prostate or vesicles. No pus in the secretion expressed from these organs or in solution passed thereafter.

Posterior Urethritis.—No pus at meatus, unless there is anterior urethritis as well. (Clinically there is almost always enough anterior urethritis to produce a morning drop.) Second flow of urine may be clear or cloudy. Prostate and vesicles feel normal, but in the secretion, expressed or centrifuged from the solution, there are pus cells.

Prostatitis.—Same as posterior urethritis except that indurations or abnormalities of contour are usually discerned in the prostate, and the expressed secretion is frankly purulent. There may be residual urine.

Vesiculitis.—Same as prostatitis, except that vesicles are distended or indurated. Just as there is always prostatitis with vesiculitis, so there is often impalpable vesiculitis with prostatitis. The attempt to distinguish the expressed secretion of the two is likely to prove misleading, for though a large part of the vesicular secretion floats in urine, pus from the vesicle, like pus from the prostate, sinks.

Stricture.—Marked stricture obstructs or prevents the passage of the catheter. Slight stricture is not diagnosed until a subsequent examination. Cicatricial or prostatic obstruction at the neck of the bladder gives residual urine.

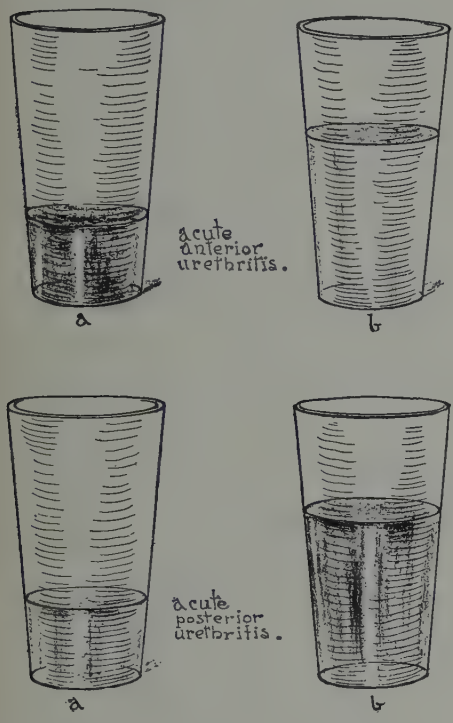

Fig. 181.—Two-glass Test.

Acute anterior urethritis shows pus in the first glass only. Acute posterior urethritis shows pus in both glasses.

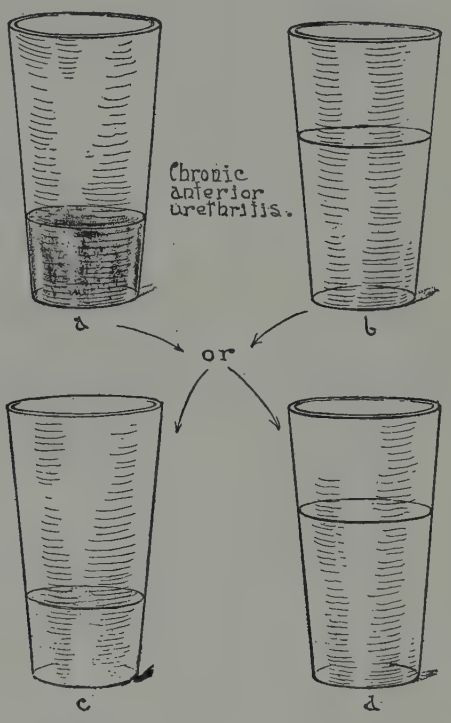

Fig. 182.—Two-glass Test.

Chronic anterior urethritis shows pus and shreds in the first glass or only a few scarcely visible shreds in the first glass.

Cystitis.—It is probable that some inflammation of the trigone exists whenever the second flow of urine is purulent. But this is a negligible quantity that disappears long before the posterior urethritis is cured. Retention cystitis is, of course, important.

Pyelonephritis.—The diagnosis of gonorrheal pyelonephritis offers no peculiar difficulties excepting in so far as urethritis prohibits cystoscopy. The renal colic due to vesiculitis and the lumbar pain due to epididymitis are distinguished by physical examination.

Object of This Method of Examination.—The object of this examination is to obtain the maximum of information about the patient while doing him the least possible harm. By it the precise lesion in the anterior urethra is not as accurately determined as though the urethroscope were used. But the risk of stirring up a urethra whose temper is not known warrants deferring this more precise examination to a subsequent date, the following day, if the patient cannot be kept under observation, but preferably after a few days of treatment, unless the case is very chronic and the temper of the urethra has already been well tested by others.

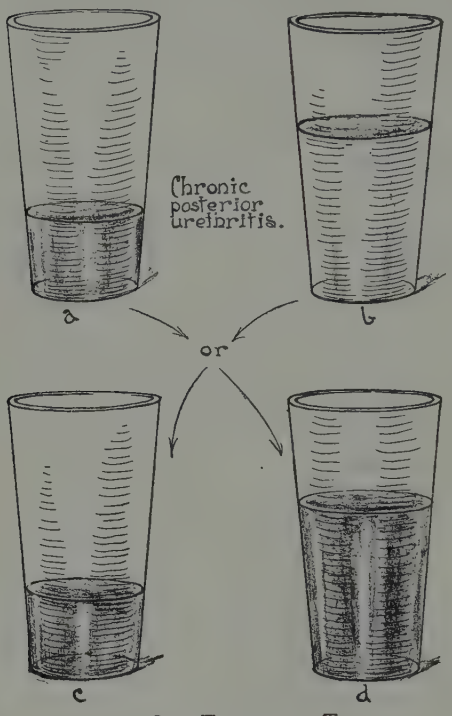

FIG. 183.—TWO-GLASS TEST.

Chronic posterior urethritis shows pus or pus and shreds in the first glass alone or in both glasses.

Secondary Examination.—In order to obtain precise information as to the condition of the anterior urethra one must use an exploring instrument. I usually employ a 28 F. bulbous bougie. (The meatus may have to be cut.) If this is grasped there is stricture. If it is not grasped but brings blood (not from the meatus) there is anterior urethritis. The precise surface conditions of both anterior and posterior urethra are determined by—

Urethroscopy.—See Chapter V.

Contra-Indications.—Acute relapses or complications (*e.g.*, in prostate or epididymis) prohibit instrumental examination until they shall have passed.

Inferences Drawn.—The diagnostic horizon is not limited by physical signs. We find by our examination that the patient has this, that, or the other lesion; indeed, we usually find that he has several lesions. But before the diagnosis is really complete we must know which is the predominant lesion and what part the patient's general condition plays.

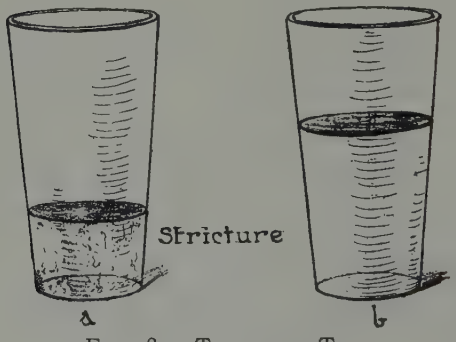

FIG. 184.—TWO-GLASS TEST.

Stricture shows large shreds in the first glass of urine.

Our examination reveals, let us say, prostatitis, anterior and posterior urethritis. Under these conditions we may feel confident that one of these

lesions is more important than the others; is indeed the underlying lesion that keeps the others going. It may be that prostatic massage alone will cure the case promptly and permanently. Or maybe posterior irrigation is required. Or perhaps any attack of the posterior urethra does harm and the patient will recover on an interior injection. Or dilatation may help. Or any local treatment may irritate.

These are not theoretic possibilities but practical facts. Diagnosis of the lesion is necessary, but an absolute therapeutic conclusion can rarely be drawn from that diagnosis. We must feel our way and try first one treatment and then another.

Concerning Shreds.—The purulent urine of acute urethritis does not contain shreds, but as the inflammation subsides and tends to become localized little scabs form upon the more inflamed areas and are washed away in the urine. These are called shreds (Tripperfaeden). They consist of a mass of mucous or fibrous matter entangling pus and epithelial cells. To the general practitioner shreds simply mean that the general inflammation is subsiding or has subsided. When, day by day, the urine shows less pus and more shreds, conditions are improving. The following general observations concerning shreds seem warranted:

1. Shreds are no index of gonorrhea. They are currently found in the urine passed by men who have never had gonorrhea.
2. The shape and size of shreds do not indicate what part of the urethra they come from.
3. Shreds mean chronic localized inflammation of the urethra.
4. Shreds heavy with pus sink rapidly in the urine. They indicate relatively active inflammation or ulcer or stricture.
5. Lighter shreds often testify to an inflammation so mild that it presents no dangers and is entirely uninfluenced by treatment.
6. Shreds of any size call for treatment by dilatation or urethroscope (unless this irritates).
7. Many patients with shreds cannot be rid of them. A few thin ones will persist.

CHAPTER LXXVI

SYSTEMIC TREATMENT OF URETHRAL GONORRHEA

The efficacy of local treatment in repressing acute urethral gonorrhea leads many practitioners to forget the old "methodic" treatment, the sole reliance of our fathers. The methodic, or systemic, treatment of acute gonorrhea has indeed been relegated to second place; yet it is still important, not only when repressive local treatment is inapplicable, but also as an accessory to this local treatment. The hygienic and dietetic part of the treatment is of the utmost importance. If disregarded, the best directed efforts may miscarry.

CLEANLINESS

The parts should be washed as often as required, soap and warm water being as good as an antiseptic solution and more readily at hand. The discharge should be kept from smearing the underclothing. If the foreskin is long, the glans penis may be thrust through a slit in the center of a small square of gauze until the slit lies snugly behind the corona glandis; thus held in place, the gauze is folded forward over the glans penis, covered by replacing the foreskin, and left puckered up and long enough to protrude in a bunch in front of the preputial orifice.[1]

In as much as suspension of the testicles is advisable as a preventive of epididymitis, a jock-strap should be worn. This will act, incidentally, as a bag to contain the gauze or cotton garnishing the meatus.

Finally, the patient must be told the danger to his eyes from contamination with his urethral pus, and cautioned to touch the genitals as little as possible and to *wash his hands thoroughly with soap and water every time he has touched his penis.*

DIET

The rigorous diet usually prescribed excludes all alcohol, spices, rich and indigestible sauces and foods, fruit, coffee, tea, and sparkling water. I have found it of no benefit to the patient's urethra to be so strict, and a great encouragement to his mind to permit a greater latitude. Alcohol, spices, and condiments must, of course, be prohibited, and it is well to specify ale, beer, cider, and ginger ale, besides insisting that any substance which burns the

[1] The pledget of absorbent cotton, which is so efficient when the discharge is mild, retains the more profuse discharge in contact with the head of the penis, thus preventing proper drainage of the inflamed urethra.

palate as it enters the body will burn the urethra as it issues forth (we speak, of course, of chemical, not of physical heat). Indigestion, whether from overeating or from indiscreet eating, is harmful, and acid fruits, especially lemons and grape fruit, as well as asparagus, are apparently irritating. But there is no reason to prohibit these absolutely nor to prohibit tea or coffee at all. I do not prohibit sparkling waters.

REST

Physical rest is most important. Were it possible for the business of the world to be transacted with all the sufferers from acute gonorrhea in bed, and were rest in bed not the very worst thing for the state of mind of these same sufferers, it would be wiser to place them all upon their backs. But, taking the world as it is, the best plan is to urge each patient to rest as much as may be; to ride rather than to walk, to sit rather than to stand. Railroad and automobile trips seem to be a peculiarly injurious form of locomotion.

SEXUAL HYGIENE

Absolute continence is essential, with the avoidance of anything liable to induce sexual excitement—association with women, racy books and pictures, erotic thoughts *et id genus omne.*

Such is the general rule; yet I have known patients accustomed to frequent sexual intercourse to be constantly distressed by painful erections unless they relieved their sexual tension by cohabitation (with a condom). Such license should nevertheless be absolutely prohibited. Massage of the prostate and vesicles cannot wholly replace it.

DILUENTS

Unless he is taking balsamic medication the patient should drink (between meals if he is dyspeptic) about eight glasses of water a day. Ordinary drinking water suffices, but, if he can afford it and it does not prove too diuretic, an alkaline diluent, such as Vichy Celestins, is preferable.

But here again common sense must temper routine practice. In acute gonorrheal cystitis and in very acute posterior urethritis more harm may be done by the muscular straining attending the frequent repetition of the urinary act than is atoned for by any amount of dilution of the urine.

INTERNAL MEDICATION

The drugs that may be effectively exploited to combat acute urethral inflammation belong to five orders:

1. Urinary antiseptics
2. Alkalies
3. Demulcents
4. Anodynes
5. Balsamics

1. Urinary Antiseptics

Urinary antiseptics, such as hexamethylenamin, methylene-blue, salol, benzoic acid and the benzoates, boric acid and the borates, have no recognizable influence upon urethral inflammation. Theoretically, they ought to be of paramount importance, but practically these substances, so valuable in suppurative conditions of the urinary tract above the bladder, are useless below that point, whether because their bactericidal efficiency is slight, or because their sojourn in contact with the inflamed urethral wall is limited, or because the bacteria are shielded from the antiseptic action of the medicated urine by the tissues in which they lie. The value of hexamethylenamin and of methylene-blue in acute gonorrhea has been vaunted. In my opinion it is slight; so slight that it does not deserve consideration.

Yet hexamethylenamin is very useful to protect the kidneys. It should be given whenever there is an unexplained rise of temperature in the course of a gonorrhea.

2. Alkalies

The virtue of alkalies in the treatment of urethral inflammations depends rather upon the condition of the urine than upon the grade of the inflammation. The urine, normally acid and often dense, is, *ipso facto,* harmful except in so far as it washes the urethra, and the alkali is negatively a very good thing, but good only when required to counteract acidity. In other words, there is no specific action whatsoever in the alkalies. They do not in the least control suppuration. If one had two burned hands, and placed one of them in vinegar and water and the other in a watery solution of bicarbonate of soda, he would doubtless prefer the sensations experienced in the hand immersed in the mild alkali, and so it is with the urethra.

Patients having normally bland, alkaline, dilute urine (and there are many such) stand in no need of alkalies, and, indeed, may occasionally be injured by them, through indigestion.

When the urine is acid an alkali is indicated. If the urine be also dense a diuretic alkali is called for; if dilute (sp. gr. 1.015 or less) the diuretic quality is not needed.

Alkalies produce the greatest effect relative to the size of the dose, if administered toward the end of the second hour after eating.

Bicarbonate of Soda.—This is the mildest of the alkalies. Its chief virtue

is that it aids digestion, while the other alkalies impede digestion more or less. Dose, 0.50 to 1 gram. It is prescribed in the form of tablets.

Sweet Spirits of Niter (Spiritus Etheris Nitrosi).—Sweet spirits of niter is notable for its anodyne rather than its alkaline properties. It is chiefly employed for the slight irritation of the bladder so common in women. Dose: 2-6 grams, in water.

Potassium Citrate, Potassium Acetate, Liquor Potassæ.—These three salts are employed more than any other as urinary alkalinizers. The citrate is the most efficient as an alkali, but irritates some stomachs, the liquor the most anodyne, the acetate the most diuretic. Therefore the liquor is most useful in acute cases, and the citrate in chronic cases. The acetate is a stronger diuretic than the citrate, but I have found it also more irritant to the stomach. The dose of each drug is about 0.5 gram in a considerable quantity of water. The disagreeable taste is well disguised by syrup of cinnamon.

Bromid of Potassium.—This acts as an alkali and is sometimes efficient in controlling the smarting upon urination.

3. Demulcents

Demulcents are much less used now than formerly, but may be comforting when combined with an alkali. To this class belong flaxseed tea, gum water and elm-bark water, the various fluid extracts made from buchu, pareira brava, uva ursi, triticum repens, and cornsilk.

4. Anodynes

Anodynes are called for to moderate pain or urination, and for this bromid of potassium or the tincture or fluid extract of hyoscyamus generally suffices. A favorite old-fashioned prescription is:

℞ Liq. potassæ	ʒ ij-vj	(8.00-25.00	gm.)
Tr. hyosc.	℥ ss-j	(15.00-35.00	gm.)
Syr. cinnam. .....q. s. ad	℥ iij	(100.00	gm.)

M.

Sig.—Teaspoonful in water two hours after each meal (or oftener).

For Intense Chordee.—Lupulin in doses of 2 to 4 grams taken upon retiring is sometimes effective, or a similar dose of the bromid of potassium. The coal-tar products are useless, codein feeble, opium risky. Hot water is a good preventive, cold water a quick relief (as stated below). The patient should sleep lightly clad in a cool room.

For Painful Urination.—The anodyne mixture given above is excellent. Codein or bromids may be added for a severe case of acute cystitis. It is an advantage to instruct the patient suffering from this complication not to empty his bladder completely, but to let the last of the urine dribble away without the

aid of the distressful piston stroke. The instruction is hard to follow, but it may afford great relief. The uses of water in this connection are mentioned below. The rôle of the prostate must not be forgotten.

Hot water is of value in various ways. When the pain on urination is intense it may be somewhat moderated by immersing the penis in very hot water and urinating into it. Prolonged soaking of the penis, just before retiring, in water as hot as can be borne, will often prevent or moderate chordee during the night.

A hot hip bath is full of comfort for the patient with any form of acute prostatic, vesical, or seminal vesicular inflammation. Such a bath may be repeated every few hours. It should be short, not lasting more than five minutes. The temperature of the water at first should be near 104° F., and after the patient is in the bath more hot water should be added until the temperature is as high as he can tolerate.

The hot rectal douche (p. 184), once or twice a day is even more efficient.

Iced water is useful when the penis is erect and in chordee. The patient naturally urinates at once, if he can, and then by pouring iced water over his turgid and unruly member, or by placing it alongside a cold piece of metal, he strives to reduce it to subjection. To break a chordee is to invite stricture.

5. Balsamics

Balsamics have fallen into almost complete disrepute in the treatment of acute gonorrhea in this country. This is, in part at least, because of the general misapprehension of the way in which they should be given. The benefit derived from balsamics depends upon their concentration in the urine. Hence they should be given to the point of saturation and *with as little dilution of the urine as practicable*. Thus given, they distinctly alleviate the discomfort due to gonorrhea and even markedly control the inflammation. (They are equally efficacious for other infections of the urethra and prostate.)

Thus the decision to administer balsamics during acute gonorrhea depends chiefly upon the failure of local treatment, diluents and alkalies to control the inflammation. The less active the inflammation, the less the virtue of any general medication.

Sandalwood Oil.—Oleum santali flavum seems fully as efficient as any of the synthetic remedies that have been devised to supplant it. Gonosan or arrhovin need be employed only by the patient who cannot digest the sandalwood oil.

The drug is administered in 5 minim capsules. These should be given six times a day (at three-hour intervals), and the dose increased by doubling the size of two doses each day until twelve capsules are being given a day or the digestion rebels (colic, eructations, diarrhea) or pain in the loin appears. If these symptoms of poisoning occur, the dose should be reduced to the limit of toleration. If six capsules a day cannot be given a therapeutic effect can scarcely be expected.

Copaiba (overdose of which occasions erythema), cubeb, wintergreen oil, and kava-kava are among the more popular substitutes for sandalwood oil as ingredients in antigonorrheic capsules.

INSTRUCTIONS TO PATIENTS

Of late years the commendable practice has arisen of distributing to dispensary patients, suffering from venereal diseases, a card indicating the chief dangers of the disease and the precautions they personally must take to encourage speedy cure and to protect their fellows. The following list has been approved by the Associated Clinics of New York City:

INSTRUCTIONS TO THOSE HAVING GONORRHEA

"You have a serious contagious disease. It may continue for years after the discharge ceases and you seem well. Therefore you must not marry or have any sexual relations until a reputable physician has pronounced you cured.

"A woman with this disease may become sterile, or be an invalid for life, or have to undergo a very serious and mutilating operation. A child born to a woman with this disease is likely to become blind.

"For your own protection, and the protection of others, observe the following precautions:

"1. Always wash the hands after handling the parts; the discharge, if carried to the eyes, will make you blind.

"2. Sleep alone, and be sure that no one uses your toilet articles, particularly towels and wash cloths.

"3. Never lend your syringe to anyone, and as soon as you are well, destroy it.

"4. Avoid all sexual relations and excitement.

"5. Be sure that the bowels move every day. If constipated, take a laxative.

"6. Do not use alcohol in any form, as it always prolongs the disease.

"7. Drink from six to eight glasses of water a day.

"8. Avoid all spicy food and drink, as ginger ale, mustard, pepper and horseradish.

"9. So long as the discharge is free, walk as little as possible."

GENERAL TREATMENT OF CHRONIC URETHRITIS

General Hygiene.—Many of the general hygienic rules for the treatment of acute gonorrheal urethritis do not apply to the treatment of chronic inflammations. Thus the *diet,* which should be light during the acute period of the disease, should be rather full and stimulating in the chronic stages. *Exercise,* which is always harmful in acute gonorrhea, is often beneficial to a chronic case. Exercise should not only be permitted, but should be encouraged. There is no

reason to prohibit even such violent pastimes as tennis and swimming, to a patient suffering from chronic urethritis; *but they should be begun gradually,* and the patient should feel his way, taking more and more exercise as he assures himself that it does him no harm.

The intelligent use of *alcohol* is one of the most thoroughly misunderstood points about the treatment of chronic urethritis. Although we realize that many of the drugs and methods of local treatment employed for chronic urethritis are used chiefly because they are irritating, yet we forget that alcohol is one of the best known urethral irritants, and we are too much inclined to scoff at the story of the patient who, despairing of a cure after many months of treatment for his local urethritis, breaks training, enters a wild debauch, and comes out of it cured. Such a case is not the exception that proves the rule, but is only an illustration of the rule that what we seek for the cure of chronic urethritis is the proper irritant, and alcohol sometimes fits the case. *Alcohol is almost universally harmful so long as gonococci can be found in the urethral pus* (though there are rare exceptions even to this rule); but after the gonococci have disappeared, if the patient is an habitual drinker, it is proper to urge him to return gradually to the use of alcohol, and such a course frequently has a most beneficial effect, both upon the patient's mind and upon his catarrh. It is an exhibition of intelligence on the part of the physician to cure his patient by giving him whisky to drink, rather than to run the risk of permitting the patient to make this experiment for himself.

Other hygienic measures, such as sending a patient away from the city to the country, or bidding him change his climatic conditions by a trip at sea or to the mountains, are very rarely called for. Yet, when local measures fail after a thorough trial, it is imperative that the patient leave his work and his home to take a vacation. Under such conditions a brief trip may well effect cure, or at least put the patient in such a condition that local treatment, which previously was ineffective, will now prove curative.

Sexual Hygiene.—While gonococci persist sexual intercourse is as likely to reinfect the gonorrheic as it is to infect his partner. But after their disappearance it is likely to do good by relieving the sexual congestion of one who is (presumably) accustomed to frequent sexual intercourse. The irritation of ungratified sexual desire, the effort to check the sexual habit, is to many gonorrheics the most distressing feature of the disease.

Drugs.—Most cases of chronic urethritis may be treated successfully without any internal administration of drugs. Very exceptionally a patient is benefited by the internal administration of balsamics or alkalies. More commonly, a brief, severe course of water drinking will cure a mild catarrh by flushing the canal. The alkaline mineral waters are, apparently, the best suited for this purpose. Urotropin is employed as an antiseptic preliminary to the use of sounds or dilators, and for the treatment of pyelonephritis or bacteriuria. Alcohol should be used intelligently, as stated above. Tonics may be required.

CHAPTER LXXVII

LOCAL TREATMENT OF ACUTE GONORRHEA

The local treatment of acute gonorrhea comprises five entirely distinct subjects, viz.:

The preventive treatment
The abortive treatment
The repressive treatment
The terminal (expectant) treatment
The treatment of complications

PREVENTIVE TREATMENT

The man who practices promiscuous cohabitation sooner or later catches gonorrhea in spite of every precaution. The condom is still "a cuirass against pleasure, a cobweb against infection," as Ricord used to say. The condom may tear and so admit infection; and once in a great while one is consulted by a victim who alleges he was infected in spite of its protection. The infection in such cases doubtless results from preliminary skirmishing.

Some measure of safety is afforded by urination and thorough washing with soap and water immediately after cohabitation. To this any one of the following therapeutic measures adds a far greater assurance of safety:

Instillation into the meatus of a few drops of 20 per cent argyrol or 5 per cent protargol.

Irrigation of the anterior urethra with permanganate of potassium (1:1,000).

Injection and retention for five minutes of 20 per cent argyrol or 1 per cent protargol.

The safety afforded by any of these is approximate but not absolute. The treatment should be employed within twelve hours of the contact and should not be repeated. A traumatic urethritis, lasting a day or two, may result.

ABORTIVE TREATMENT

In the production of chronic urethritis the abortive treatment has taken the place of the sound of our forefathers.

In exceptional cases it is possible to abort gonorrhea. Indeed, in some cases gonorrhea almost aborts itself. But *it is almost impossible to abort a first gonorrhea,* and often impossible to abort subsequent attacks. After experimenting with every method of aborting gonorrhea I ever heard of, it is my present con-

viction that *the surest way to abort gonorrhea is not to try to abort it.* The treatment employed should be *repressive.*

REPRESSIVE TREATMENT

The repressive treatment of acute gonorrhea consists in the employment of local treatment calculated to control the inflammation; but with the prime object of lessening the symptoms, the complications, and the prospects of chronicity, not of cutting short the acute attack. The systemic treatment described in Chapter LXXV is always employed. Repressive treatment occasionally and quasi-accidentally results in abortion of gonorrhea. Indeed, I believe it so results quite as often as the abortive treatments, while it has the supreme advantage of leaving those cases that are not aborted soothed rather than irritated and in the best possible condition to weather the weeks to come.

Cases Suitable to Repressive Treatment.—The physician unfamiliar with the local treatment of urethral disease can expect but little success with the repressive treatment of gonorrhea. The expectant treatment will give him better results.

The physician moderately familiar with the subject should undertake this treatment with fear and trembling. He should apply it at first only to cases that he can absolutely control, who apply for treatment during the initial stage of the disease, before the meatus is much swollen, the discharge free, the "second" urine cloudy, or pain on urination or erection present. This admits most cases from one to three days old.

The expert will determine how far his personal success permits him to disregard the above rules. None of them are absolute to him, so long as he proceeds gently and is in no hurry to get the patient well.

Choice of Repressive Treatment.—The ideal antiseptic for the gonococcus has not yet been discovered. We therefore describe the three types of treatment generally employed, acknowledging our preference for the first named, and insisting only on the early use of mechanical treatment in the declining stage of the disease.

Acriflavin.—This drug was first employed as an antiseptic by the British during the World War. It proved of little value as a dressing for inflamed wounds, but singularly efficacious in preventing fresh wounds from becoming infected during transfer to Base Hospital. Young sent some of the drug to Johns Hopkins where it was studied and first used in the treatment of gonorrhea. Its use in a strength of 1:1,000 was advised. Subsequent experience has proved this much too strong. Any one employing acriflavin in the urethra must bear in mind its peculiar property to *irritate without causing discomfort.* In using any other drug the patient may be depended upon to note irritation. Not so with acriflavin. It will produce stricture quite painlessly. I have known a patient to produce with it a lesion that looked like a chancre of the meatus, blissfully unconscious that he was doing himself any harm.

Hence *the acriflavin treatment must be given only by expert urologists and never entrusted to the patient.* The rules to be followed with the utmost precision are:

1. Inject only the anterior urethra until anterior urethritis is controlled.
2. Use a syringe (bulb or piston) of the most delicate description which will register the lightest resistance of the patient's urethra. Thus only may one surely avoid trauma. The string-wound piston is taboo. The piston must be of ground glass; the bulb, if bulb is used, old and soft.
3. The amount injected must not exceed 10 c.c.
4. The solution should be 1 : 2,000 and not more than a few days old, made from stock 1 per cent solution which will keep a month.
5. The injection is given but once a day; held in the urethra for one minute.

The question whether one brand of acriflavin is better than another I am unable to decide.

For a time we used permanganate of potassium in conjunction with acriflavin. Later we have discontinued its use.

Argyrol.—Argyrol should be employed with the same extreme of gentleness in 10 per cent solution, freshly made, and retained in the urethra for ten minutes four times a day. The patient may use this injection himself, but should visit the physician daily.

Protargol.—This should be employed like argyrol, but in strength of from 0.25 to 0.50 per cent. Kreissel injects 0.125 per cent for one minute every two hours during the day and twice during the night. On the fourth day he changes to 0.25 per cent every three hours by day and once during the night. Four days later 0.5 per cent every four hours by day and retained five minutes.

Potassium Permanganate.—Janet introduced the use of this drug. Though I do not employ his method of treating anterior urethritis, yet potassium permanganate is universally recognized as the most generally useful mild antiseptic for the treatment of almost every variety of infection of the urinary organs.

He irrigates the anterior urethra twice a day for three or four days, then increases the interval from twelve to eighteen hours. When the cloudiness of the first urine is pretty well gone, he makes the interval twenty-four hours. When the discharge is no longer purulent, he makes it forty-eight hours.

When the second urine becomes cloudy, he irrigates the posterior urethra according to the same method, twice a day at first, later every day or every other day. For each irrigation, of anterior or posterior urethra, he employs 500 c.c. of fluid, at a temperature of 110° F.

If the case is seen before the appearance of marked inflammatory symptoms, he employs a 1 : 500 solution of permanganate, immediately followed by a like quantity of boric acid solution. If this does not prove too irritating, he continues at this strength until the inflammation has subsided sufficiently to permit intervals of thirty-six to forty-eight hours, when he drops to 1 :4,000 to 1 :6,000 permanganate and omits the boric acid.

If the posterior urethra becomes inflamed, he begins irrigating it with solutions of 1 : 4,000 down to 1 : 10,000. If these are well borne, he increases the strength to 1 : 2,000 or 1,000, and follows it with a boric acid irrigation.

If the patient is first seen after the appearance of acute inflammatory symptoms, the irrigation is begun at 1 : 10,000 to 1 : 4,000 strength, and only for the anterior, even if the posterior urethra is inflamed. He begins treatment of the posterior urethra only when the anterior inflammation is under control.

In the declining stage he gives a daily irrigation of 1 : 6,000 to 1 : 8,000.

Other Methods.—Valentine and the other followers of the Janet method in this country follow his method with certain variations. They usually employ much weaker solutions (1 : 4,000 to 1 : 20,000) and larger quantities (1,000 c.c. or more), and often irrigate the posterior urethra every day or every alternate day as a routine measure.

Results of Repressive Treatment.—The success of the repressive treatment of gonorrhea, by whatever method, is not universal. Success depends upon the skill and gentleness of the practitioner and upon the intensity of the infection. First infections are much less controllable than subsequent ones. Duration of the gonorrhea, intensity of anterior urethritis, are adverse phenomena which usually forbid the attempt at repression of a gonorrhea, and render its success dubious in any case.

The test of the success of repressive treatment is diminution and disappearance of the patient's subjective symptoms (pain or discomfort). The patient must be impressed with the fact that the success or failure of the treatment is in his hands, and that *the sign of danger is pain,* the cause of pain trauma. He must be gentle in injecting, gentle in compressing the meatus, and should not repeat an injection in case a first effort fails.

Pain is never the same in any two cases. To say that an injection of protargol to be efficient should be painless, is obviously untrue. But *each successive injection should be less painful than its predecessor, and the appearance of any new or increased pain at any time is the one signal that calls for immediate cessation of local treatment.*

Moreover, it is expected that the discharge, the gonococci in the discharge, and the pus in the urine will daily grow less. Accordingly, *examination of the meatus, smear of discharge (if any) for gonococcus examination, and passage of urine in two glasses are essential preliminaries to each treatment.*

If things go badly, it is vain to try frantically one treatment after another; all local interference must be discontinued immediately.

If things go well, the discharge promptly lessens and gonococci disappear from it within a few days. All discharge may even disappear after the very first injection. Yet we are well aware that gonococci are still present in the mucosa. Their eradication is our next problem. This may be termed the *stage of control or decline.*

Treatment of the Stage of Control.—The outstanding feature of many a case of gonorrhea when it has reached this *stage of control or decline* is that

it declines to decline any further. Perhaps for a few days only, perhaps for weeks, pus and gonococci vary but little; more one day, less another; complete disappearance of all pus followed in a few days by recrudescence. We know that the cause of this is an uncontrolled focus of infection in some lacuna or gland, the occasion usually some variation in the patient's sexual life. What shall we do about it? To change from one antiseptic to another does not avail. We must attack the focus in the mucosa, *by the passage of sounds.*

In discussing the diagnosis of cure of gonorrhea we have shown that sounds must be passed and that this may be done with impunity even if gonococci are still present, if only the sounds are passed gently. The same is true here.

Accordingly, after the acute infection is controlled, even though there is still some pus in the urine, even though there are still some gonococci in this pus, but on condition that improvement has come to a standstill, one proceeds as follows:

After the patient has urinated the injection is made as usual; then a 22 F. sound is passed gently—but, oh, so gently! to the bulbous urethra and no further.

The next day witnesses an increase in both discharge and gonococci. Injection is continued as before. Within a few days the infection is again controlled. Four days later the sound is passed as before; the same size if the reaction has been sharp, the next size larger if it has been mild—but no further than the bulb in any case until size 25 F. has been reached with no reaction. Then, after the usual four-day interval, acriflavin is forced, slowly and with the utmost gentleness, into the posterior urethra. One feels the resistance of the sphincter, one calls upon the patient to relax his muscles and to go through the motion of passing water and then, as the resistance of the sphincter is felt to give way, about 5 c.c. of solution is passed into the posterior urethra. Then a 25 F. sound is once again, oh, so gently! introduced into the posterior urethra until its shaft lies at about 45 degrees from the horizontal and its point is in the bladder, but no further for fear of bruising the posterior urethra too severely.

Thereafter the whole urethra is injected daily in the same manner until once again a four-day interval of control has elapsed. Then the sound is passed as before, and so on, until a 28 F. sound can be passed without exciting any reaction whatever (the meatus may have to be cut). The patient is seen and injected thereafter thrice in the first week, twice in the second, the sound passed and the prostate massaged (on different visits) once a week, and if no reaction occurs and the urine and the prostatic secretion are free from pus for this two weeks he is discharged as cured.

This is no abortive treatment. It takes at least six weeks, often eight. But it cures the average patient quicker than any other method and proves him cured with greater certainty. Only exceptionally, and in patients the temper of whose urethra is proved by previous infections, may it be abbreviated.

Treatment of Posterior Urethritis.—Freedom from posterior urethritis, absence of pus from the second glass of urine, has been assumed in the pre-

ceding description. Indeed, posterior urethritis is, generally speaking, a contra-indication for repressive treatment. The physician who attempts to repress the posterior urethritis of a first gonorrhea is foolhardy. In subsequent attacks he does so at his peril. But the posterior urethra may become inflamed during treatment. Pus appears in the second glass of urine. One may then persist in the treatment, very gently insinuating a little of the injection into the posterior urethra in the manner above described, so long as this at least controls the situation. No change is thereby indicated in the routine of treatment by sounds.

Complications.—That the repressive treatment may fail is obvious. But if once the acute infection has been repressed and sounds used, failure is inadmissible. If the infection then flares up uncontrollably, if periurethritis or epididymitis result, let the physician attribute this to his own lack of dexterity or care. No such complication has occurred in our practice.

EXPECTANT TREATMENT

Should the acute gonorrhea be so far advanced that repressive treatment is deemed impracticable or should it be tried and fail, the case is to be treated expectantly by systematic medication and hygiene. In the course of three or four weeks the disease will reach its culmination and begin to abate spontaneously, unless complications arise (see below). Then one begins repressive treatment as above described. But we are not now dealing with a normal urethra attacked by an acute infection. The acute infection has already produced various lesions in the urethra which must be taken into account. There may be prostatitis or other complications, and in the end the patient may be left with a post-gonococcic urethritis. These require their appropriate diagnosis and treatment.

TREATMENT OF COMPLICATIONS

Abscess of the Urethral Glands.—Acute relapse or chronic prolongation of gonorrhea because of infection of the glands or of the para-urethral ducts is a matter for treatment in the chronic stages of the disease; nothing can be done while the whole urethra remains acutely inflamed.

Periurethritis.—Stop repressive treatment.

All pus formations about the urethra, whether diffuse or circumscribed, are treated during the acute inflammatory stage on general surgical principles—by rest, protection from friction and injury, moist weak bichlorid or mild carbolized wet dressing under gutta-percha tissue. Incision is required as soon as the abscess is as large as a pea. When the abscess projects internally and not externally, an attempt should be made to open it from within through a urethroscope.

The operation for frenal and other fistulæ are described in Chapter LII.

Spongeitis and Cavernitis.—*Chordee,* the commonest evidence of inflammation in the corpus spongiosum, is a contra-indication to repressive treatment.

If the erections are rendered more painful by the injections these must be stopped. Chordee is self-limited. It usually ceases in ten days. To prevent chordee the patient should eat and drink little in the evening, avoid all sexual associations, sleep under light covers, and arise to urinate in the middle of the night. To palliate it he should bend the erect penis gently downward and check the erection by immediate urination, or by first plunging the penis into cold water and then urinating. Prostatic massage has been suggested as a means to reduce the sexual tension and so prevent erections. I have not found it of any service, though one occasionally sees an amorous patient in the declining stage of acute gonorrhea benefit by sexual intercourse.

The rare, true spongeitis or cavernitis is treated by rest and cold or heat, until resolution occurs or abscess requires incision.

Balanoposthitis Lymphangitis.—These are treated expectantly.

Para-urethral Canals.—Inflamed para-urethral canals or pouches should be slit up as soon as they are recognized, unles the anterior urethra is acutely inflamed at the time.

Acute Posterior Urethritis and Cystitis.—Under this title we consider the treatment of cases of posterior urethritis unaccompanied by palpable change in the prostate, and too severe to be controlled by routine treatment of the posterior urethra.

In such cases all local treatment of the urethra must be abandoned. The patient is persuaded to rest as much as possible, in bed if the pain is very severe. Some sedative, such as the liquor potassæ and tincture hyoscami mixture, is administered. The bromids are, next to opium, the best sedatives; they may be added to the above mixture.

To alleviate pain I usually advise the constant application of a hot-water bag to the perineum, and a sitz-bath of five minutes in water as hot as can be borne, to be taken twice a day, or, if it gives great relief, before each micturition.

Hot rectal douches should also be given each day and the prostate massaged with the utmost gentleness every other day to prevent or control, if possible, the progress of gross suppuration in it.

Should this treatment fail to control the symptoms within a week, prostatic abscess, acute vesiculitis or acute pyelonephritis may be suspected; or there is a stricture left by a previous infection, or tuberculosis, or stone.

Prostatic Abscess.—Outside of hospital practice one sees the non-gonorrheal prostatic abscess rather more frequently than the gonorrheal. In hospital cases, four out of five are gonorrheal.

In Chapter XX we have pointed out the impossibility of distinguishing sharply between acute prostatitis and prostatic abscess. Any acutely swollen prostate may contain abscesses. The best rules of treatment are the following:

1. Prevent prostatic abscess by discretion and gentleness in local treatment.

2. Treat prostatic abscess as an acute posterior urethritis unless there is (*a*) complete retention of urine, (*b*) continued high fever, (*c*) unbearable painful

urination, (*d*) a distinctly soft or fluctuating point detected by rectal examination, or (*e*) a sense of great distention, pain and heat referred to the rectum.

3. Retention may be attacked by catheter for twenty-four hours. If it does not then yield, operation is required.

4. The other conditions enumerated above, unless relieved in a few days, call for operation.

Seminal Vesiculitis and Deferentitis.—The seminal vesicle very rarely requires treatment during acute urethral gonorrhea. Acute inflammation in it is rare and is habitually but a minor accompaniment to a more important acute prostatitis. The treatment is the palliative treatment of acute prostatitis.

When active suppuration occurs in or about the vesicle, this is usually not discovered until adhesion with the bowel has taken place. In this event the abscess should be incised from the rectum. But if suppuration tends to spread off into the ischiorectal fossa or threatens the peritoneum, vesiculotomy should be performed.

Epididymitis.—See page 568.

Pyelonephritis.—See page 147.

CHAPTER LXXVIII

LOCAL TREATMENT OF CHRONIC URETHRITIS

THERE is no occasion for the existence of chronic gonococcic urethritis. Proper treatment of acute gonorrhea will eradicate the gonococci within three months. And should the case be seen for the first time after it has existed for many months it may be localized, by the treatment described above,[1] to one or more circumscribed spots; *e.g.*, prostate or vesicles, where massage will bring it to the surface and cure it; infiltration that requires massage by sound or dilator; abscess or fistula, where surgical drainage does the business; lacuna or para-urethral duct, or posterior urethral granulomata, requiring urethroscopic treatment.

In treating chronic urethritis the following fundamental considerations are to be borne constantly in mind:

1. **Accurate Diagnosis.**—This must begin with the individual, not with his urethra. If he has a grave systemic disease, advanced nephritis, diabetes, carcinoma, even anemia, his urethritis may be quite incurable; in any case it is unimportant. The most it requires is an astringent injection once or twice a day.

If the patient is substantially sound the diagnosis of the urethral lesion should be made prudently, gently, with the greatest possible precision and yet with the utmost reserve. The lesions are commonly multiple. What appears to be the predominant lesion one day may be subordinate the next. The very diagnosis may stir up dormant foci of infection. If the treatment of a given lesion does not produce results, begin the diagnosis all over again, as described in Chapter LXXV.

2. **Economy of Treatment.**—The less done for and to the urethra the better. After the departure of the gonococci only *good sexual habits, good surgical drainage and the destruction of granulations are required.* Many cases will establish all this on a basis of good sexual habits, without even the assistance of an astringent injection. Indeed this consideration often overrules the requirement of thorough diagnosis, or rather the experienced urologist makes his diagnosis without running the risk of damaging the urethra by too much poking. So many gonorrheas will get well if only sufficiently let alone!

[1] Chronic gonococcic urethritis need not necessarily be attacked by the drugs mentioned in the last chapter. The infection is less vigorous and may be well handled by the astringent injections or irrigations.

3. **Sexual Hygiene.**—What caused the gonorrhea is what keeps it going. Chronic postgonococcic prostatitis is a lesion which the physician may despair of curing, but he should instruct the patient how to control it.

4. **Mechanical Treatment Is the Real Treatment.**—If sexual hygiene and a little zinc sulphate or potassium permanganate do not cure the urethritis, it must be attacked by prostatic massage, dilatation, urethroscopy. Vague wandering from one wash to another will have the same influence that soap has on freckles, if they are real freckles. They may disappear during the course of treatment, but scarcely because of it.

5. **Rediagnosis.**—If the treatment does not help the patient he must have an incurable lesion, a wrong diagnosis, or a wrong treatment. At least every three months he should have a new diagnosis, including urethroscopy.

6. **Local Treatment, Even Diagnosis, May Do More Harm than Good.**—When I was young it used to be after an instillation of silver nitrate that the patient's history suddenly stopped in my case books. Nowadays it is after urethroscopy. Yet many lesions clamor for urethroscopic treatment, and a few for silver nitrate, but only if treated with discrimination and gentleness.

INJECTIONS, IRRIGATIONS AND INSTILLATIONS

Unless there is some indication to the contrary, the first local treatment to be employed upon any patient with chronic urethritis is urethral injection or irrigation. It is, perhaps, a matter of taste whether to begin, as a routine measure, by bidding the patient to use injections for the anterior urethra or to return to his physician for irrigations of the posterior urethra. No fixed rule can be given. If the discharge is profuse, it is usually, but not necessarily, wise to begin with injections. If it is slight, irrigations may usually be depended upon alone. The patient's mental attitude, the frequency with which he is able to return for treatment, and the results of experimental treatment in each direction, must be the guide in a given case.

Injection.—The astringent injections are the most generally useful. My preference is for the zinc acetate mixture employed twice a day and retained in the urethra only long enough to fill the canal. No effort should be made to prevent its reaching the deeper portions of the urethra, nor should it be forced into the posterior canal.

Whatever injection is employed may do good at first and irritate later. Its use should, therefore, be intermitted every few weeks. The chief value of this injection is that it keeps the patient clean, by controlling the discharge until time and treatment shall cure the urethritis.

Irrigation.—Having completed the diagnosis it is my custom to begin treatment by irrigating the bladder with permanganate of potassium (1 : 4,000 every day or every other day), using at the same time sounds and massage as detailed below.

Instillations.—The object of instillations is to place a few drops of a relatively strong solution upon a definite lesion. I use them for the following purposes:

1. To follow instrumentation (if irrigation has not preceded this) by sounds or cystoscopes, for the purpose of minimizing the reaction of the torn mucosa, notably in the bulb and posterior urethra.
2. To destroy granulations in the posterior urethra when urethroscopy is too painful.

I used to emplôy silver nitrate much more frequently than I do at present. It is so excessively painful to certain patients. For antisepsis acriflavin, or 1 per cent carbolic acid appear equally efficacious, but for destroying granulomata nothing equals silver. It must be as concentrated as the patient can bear it, and to this end not more than one or two minims should be injected. Silver instillations should not be repeated oftener than once or twice a week.

DILATATION

Dilatation, by massaging and causing the resorption of infiltrations of the mucosa, is the backbone of the treatment of chronic anterior urethritis. It may profitably replace urethroscopic treatment of the anterior urethra almost entirely. Heat and electricity (Newman, Le Fort) do not replace the sound.

But the theory of dilatation must be understood. The prevalent notion that a sound should be chiefly employed for the purpose of tearing open the scar of stricture, for example, is wholly erroneous. It is no more possible to diminish the amount of scar in the urethra by tearing it open than it would be elsewhere in the body. The more a scar is torn the more scar is produced. *The sound must merely massage.* The beneficial effect of the passage of sounds or dilators is directly proportionate to the skill and gentleness with which they are passed. Exceptionally the prostate is so readily inflamed by the least urethral interference that no urethral treatment of any sort may be employed. Such cases must, temporarily or permanently, do without sounds.

The sound, thus gently passed, massages the infiltrated mucosa with a minimum of laceration to its surface, though it crushes exuberant granulations. Hence, a mild hyperemia, a *straightening* out of the urethral canal, a squeezing out perhaps of some of the inflamed glands. This, if accomplished gently, is beneficial; if roughly, it is harmful. The immediate result of this hyperemia is at least an acute congestion of the mucosa. This must pass before a sound is introduced again. The ideal interval between sounds is five to seven days.

Dilators.—The sound suffices to dilate the anterior urethra (except the bulb) and the membranous urethra. The ideal size ultimately arrived at is 28 F. to 30 F. (unless there is true stricture of the penoscrotal urethra). Sounds are preferable to dilators since they may be manipulated more gently. But chronic urethritis of the bulb or of the posterior urethra may require greater dilatation,

even up to 45 F. (In doing perineal section, we note that the index finger may be introduced snugly into the normal bulb, loosely into the prostatic urethra, but tears the membranous urethra and cannot be passed through the scrotal urethra at all.) For this the Kollman dilator must be employed. But the extra power that the dilator bestows must not be abused. It should excite no bleeding if that is possible, in any case no more than a drop of blood.

MEATOTOMY

Meatotomy is often required and should be undertaken without compunction to the point of admitting a 30 F. sound. Many a urethritis fails to get well solely for lack of meatotomy. The normal urethra is a hose and a good hose has a small nozzle. But the inflamed urethra is a drain and a good drain has a wide orifice.

MASSAGE

Massage of the prostate and seminal vesicles has been the fashion since advocated by Fuller almost thirty years ago. Yet most massage does not the least good. Its use must be based upon the following considerations, which apply to the vesicles as well as the prostate, though it is convenient to speak only of the latter.

The prostate and vesicles are sexual organs and produce the bulk of the seminal fluid. While acutely inflamed their function must be held in abeyance, for an emission is a deleterious trauma. But as soon as the inflammation becomes chronic, resumption of their normal function is the basis of cure. Social considerations commonly interfere with carrying this precept out in practice. So long as gonococci linger and unless the patient is married, cohabitation may not be advocated. But that should not blind us to the fact that sexual starvation or gluttony are as bad for the chronically inflamed sexual organs as constipation and gluttony are for the chronically inflamed digestive organs.

Now one of the things that massage does is to fill this breach between sex hygiene and social hygiene. But it does this inefficiently. A constipated movement of the bowels will often squeeze out more semen from a boggy prostate than any finger can. A seminal emission is never so small as the few drops extruded by massage. Yet, for the period between the subsidence of acute gonorrhea and the return to cohabitation, massage is the best alleviation we have to offer for the treatment of chronic prostatitis and vesiculitis. As soon as the acute symptoms subside massage may be profitably begun.

At this time the prostate is usually still tense and perhaps obscured by an enveloping inflammatory edema. Within a few weeks, however, unless irritated by unusual sexual stress, the tense prostate becomes normal to rectal touch or boggy, the edema is absorbed or changes into scattered areas of induration which commonly lie along the borders of the prostate and at the apices of the seminal vesicles. The gonococci usually disappear within a month or two.

For purposes of treatment, bogginess should be considered as existing within the prostate and vesicles, indurations as periprostatic, perivesicular. If really chronic, of more than three months' duration, massage has little influence over either condition. Massage such a patient for a couple of years and he will usually end about as he started. But sexual hygiene will relieve the bogginess if anything will. This and the lapse of time will reduce induration to a minimum. The more chronic the lesion the less it will be benefited by massage.

What then can be done for chronic lesions that do not get well under sexual hygiene? In the first place, investigate the sexual problem a bit further.

As a very simple example let me cite the case of a handsome big youngster who came to my office with a boggy indurated prostate, pus, perineal pain. He stated that prostatic massage helped a lot. I found it did, for without it he complained of much pain. He confessed to cohabitation once a week. I massaged vainly for about a month before I waked up.—"How many times do you cohabit every Sunday?" "Oh, about three times."

Chronic prostatitis is often not curable. The effort to free the prostatic secretion from all pus is vain. Sexual hygiene accomplishes more than massage and habitually reduces the pus to such an extent that it no longer is found in clumps under the microscope. No more need be required.

Yet it is not to be forgotten that the cardinal symptoms attributed to chronic inflammation of these internal sexual organs (urethral discharge, pyuria, pain) are, if not due to sexual irreguarities, actually caused by lesions on the surface of the posterior urethra, such as granulations, verumontanitis, sinusitis, sclerosis of the bladder neck. The prostatic secretion may be full of pus and yet the urine free from it—and vice versa.

In short, massage hastens the subsidence of subacute prostatitis and vesiculitis, expels gonococci and is the best available substitute for sex relations. The treatment of posterior urethral surface lesions plus sexual hygiene is the treatment of chronic prostatitis and vesiculitis, with massage to control exacerbations. The symptoms, pyuria and pain, are due chiefly to urethral lesions and sexual strain. A little residual pus in the prostate is unimportant. The chronically boggy prostate needs a sexual diet. Periprostatic indurations take care of themselves. Surgical drainage of prostate and vesicles is very rarely indicated.

Technic of Dilatation.[1]—If examination with the bulbous bougie reveals an induration in the anterior urethra, which is not promptly ameliorated or cured by irrigation, it should be dilated. The dilation should be begun with sounds, and these should be carried to the limit of the meatus. The urethra should be dilated not more than three numbers at a given occasion, and the usual precautions as to hexamethylenamin and local antisepsis should be employed. The meatus must often be cut.

When the first sound is passed, the urethra should be palpated upon it to discover any perceptible infiltrations or minute glandular indurations, and if

[1] The use of electricity (Newman), hot solutions or hot sounds (Porosz, *Am. J. Urol.*, Jan., 1911), to excite hyperemia and replace dilatation, has not met with any general success

these are found they should be gently massaged each time the sound is introduced thereafter until they disappear, or until it becomes evident that they are permanent scars.

Sounding should be repeated twice a week, and when the limit of the meatus is reached, dilatation with the Kollmann dilator should be begun. In using the dilator it is often possible to advance much more rapidly than with the sound. The instrument is screwed up gently, one waits a moment, and then gently turns the wheel a trifle more. By thus turning intermittently, one gains two or three numbers with little pain to the patient and without exciting much bleeding.

I see no advantage in leaving sounds or dilators in the urethra for more than a few moments after the desired dilatation has been achieved.

It is a general rule that bleeding is a sign of too severe dilatation. Yet, if the surface of the urethra is much inflamed, the very introduction of the instrument may cause bleeding.

Contra-Indications to Dilatation.—While gonococci persist in the urethra, dilatation is dangerous. It may do good; but only if most gentle. While the urine contains free pus, even though that pus show no gonococci, dilatation is still somewhat dangerous, and should be undertaken only after every effort to clear the urine of free pus.

THE RECTAL DOUCHE

The rectal douche is essentially a treatment for acute inflammation. It may help alleviate the pains of chronic prostatitis or vesiculitis.

OPERATIVE TREATMENT

In the absence of complications specifically requiring operation, such as abscess or intractable stricture or sclerosis of the bladder neck, it is, generally speaking, unwise to operate upon cases of chronic posterior urethritis. Drainage of prostate and vesicles is, however, the only relief for grave intractable suppuration in these organs.

Operations for the Relief of Vesiculitis.—The operative relief of infections of the seminal vesicles has been attempted in two ways: by drainage through the vas deferens, and by direct operative attack upon the vesicle itself.

Belfield's Operation.—Belfield picks up the vas in the scrotum, incises it after local infiltration of the skin with cocain, injects the proximal end of the duct with 10 per cent argyrol or 4 per cent collargol, and fixes the duct in the wound so that any reflex of the fluid injected will issue from the wound itself and not flow into the subcutaneous tissue, there to cause an irritative phlegmon. He hopes thus to obtain both antisepsis and drainage of the vesicle. Edema around the little wound interferes with subsequent injections. Excellent results have been reported from this operation, and it is believed that if the vas is not completely divided or if it is brought together again by a single catgut suture so

that the two ends are opposed to each other, occlusion of the vas does not occur. Caulk states that the vas deferens is occluded in about half the cases operated upon.

Thomas has suggested that the injection be made through a needle puncture of the exposed vas. This readily finds the lumen and supplies antisepsis without drainage. Whatever form of operation is employed, care must be taken not to infiltrate the tissues about the vas.

The operation is simple enough. In my hands it has been quite without effect excepting in a few cases of recurrent epididymitis. I am inclined to suspect that the benefit in these cases has been due to occlusion of the vas at the point of operation.

URETHROSCOPIC TREATMENT

Urethroscopic treatment, as previously described, is required for the cure of those cases of chronic urethritis that fail to heal under dilatation and massage. It is therefore only employed after the more active symptoms have disappeared, chiefly for the cure of a mild morning drop and when the urine shows little or no free pus but only shreds. It often heals the last surface lesion and occasions the disappearance of the last shred—and it may fail. A few persistent shreds in the urine unaccompanied by any appreciable urethral lesion must perforce be disregarded.

TREATMENT OF URETHRAL NEUROSES

The neuroses due to chronic prostatitis and seminal vesiculitis may or may not be postgonorrheal, as has already been suggested. Yet they are often attributed to gonorrhea by the patient, and are, therefore, mentioned here.

They may be divided into three groups:

Sexual neuroses
Painful neuroses
Sexual neurasthenia

To these may be added, for the sake of convenience:

Prostatorrhea
Spermatorrhea

In order properly to treat these various conditions, an accurate diagnosis is necessary as to the presence of complications.

If gonococci are present, one must first get rid of these by appropriate measures. If the prostate and vesicles are markedly inflamed, these must be massaged until the amount of pus expressed is reduced to a minimum. If there is stricture, this must be dilated; if there is residual urine, the bladder neck must be divided. Hyperesthesia of the urethra may be dulled by sounds, that

of prostate and vesicles by the rectal douche or by cauterization of the verumontanum.

But sexual strain is the usual cause of chronic prostatic and vesicular pains, sex hygiene the essential treatment. So many of these difficulties depend entirely upon sexual irregularities and derangements that the patient's sexual habits, both previous and present, should be intimately investigated, and every effort made to lead him to as clean, as wholesome, and as normal a sexual condition as it is possible for him to attain. Although matrimony cannot be prescribed like a pill, and although these patients are often sorry subjects to place on any woman's hands, truly happy married life is often the only real remedy for the patient's condition, and, unfortunately, almost as often it is a remedy beyond the patient's reach.

CHAPTER LXXIX

SUMMARY OF THE TREATMENT OF URETHRAL GONORRHEA

Doubtless the most illuminating method of imparting one's ideas on the treatment of gonorrhea is by the case system. Let us pretend we have before us the patients whose physical condition I shall first outline.

Case 1.—Acute gonorrhea: First day. This patient has had gonorrhea before. The first gonorrhea never appears at a physician's office until several days have elapsed. Examination reveals a distinctly reddened but very slightly swollen meatus and a drop of pus containing Gram-negative intracellular diplococci. The patient urinates in two glasses, the second of which is clear. This is sent to the laboratory for examination. Rectal examination reveals nothing wrong with the prostate or seminal vesicles. An injection of 1:2,000 acriflavin is administered very gently into the anterior urethra and held there for two minutes. The patient is instructed to avoid exercise, motoring and railroad trains, to refrain from alcohol, ginger ale and all other condiments. The physician repeats the injection once a day.

The patient takes no treatment of any sort himself unless he needs a laxative because of constipation or to drink more freely of water in order to keep his urine density below 1015.

Under this treatment the discharge should promptly be controlled, the redness disappear from the meatus and the first flow of urine show only a few clumps of pus cells. At the end of two weeks a 20 F. sound is passed with extreme gentleness as far as the bulbous urethra and not into the posterior urethra. The passage of this sound is preceded by the injection of acriflavin. Before passing the sound the prostate is palpated.

The object of the passage of the sound is to find out whether there are still any gonococci in the urethra. If there are, they will by this time be buried beneath the epithelium so deeply as to be out of reach of any surface antiseptic, and the infiltrated area of the mucosa will be sufficiently traumatized by the passage of the sound to excite an acute outbreak of the gonorrhea. This will be very promptly controlled by continuation of the daily acriflavin. Five days after this control has been established, the same sound is introduced again in the same manner and this routine is repeated until the 22 F. sound in the anterior urethra excites no reaction. Although there has been no evidence of posterior urethral infection, there may be posterior urethral gonorrhea or there may be infiltrates in the anterior urethra so slight that the 22 F. sound was not large enough to traumatize them.

As soon, therefore, as the 22 F. goes readily, a 23 is passed into the anterior urethra after a four- or five-day interval, then a 24, then a 26. And since the 26 is never passed until the complete control has lasted at least two weeks, one feels safe in slipping this instrument gently into the posterior urethra. At some one of the preceding palpations of the prostate, enough secretion has been expressed for examination and the physician now has at his disposal the following facts: (*a*) The prostatic secretion is free from pus, (*b*) a 26 F. sound has been passed the whole length of the urethra without exciting any clinical reaction, (*c*) the whole infection has been so mild that it is not worth while to take a complement fixation test.

Under these circumstances I feel justified in declaring the patient well. Permit, however, the following comments: First as to acriflavin, one could doubtless do as well with other antiseptics. I used to favor 10 per cent argyrol four times a day, but the acriflavin once a day is so much more convenient that I have shifted to this. One of its greatest conveniences is that it permits the physician to conduct all of the local treatment himself. Acriflavin, indeed, should never be put into the patient's hands. It excites urethritis without pain. I have seen urethral infiltrates result from the excessive use of acriflavin, though the patient had never suffered the slightest discomfort. In the second place, one may omit the passage of a sound and terminate the treatment by gradually diminishing the frequency of the acriflavin injections, establishing the fact that there is no pus in the prostatic secretion and permitting three months to elapse from the time of infection to the time of guarantee.

Finally, let me insist, once and for all, upon the fact that out of ten men especially interested in the treatment of gonorrhea, at least eight do not know how to pass a sound gently and at least two or three are of such a physical temperament that no amount of instruction, example or exhortation could possibly teach them to pass a sound gently. Such men are disqualified as practitioners of urology.

Case 2.—The patient has his first infection and comes to the physician on the fourth or fifth day with the anterior urethra thoroughly inflamed, urinations beginning to be painful, or he has already had some local treatment but is getting worse after this experience. Such a man requires the same instructions as Case 1, he will furthermore be told to drink as much water as he possibly can, to take French vichy when he is drinking with his friends, to take one-half teaspoonful of bicarbonate of soda after each of his meals. He will be particularly instructed in the details of cleanliness and the protection of others. He will be told that his acute infection will continue to get worse for two or three weeks. He will be instructed how to minimize chordee, should this occur. During this acute period of the disease, if he gets arthritis, the joints shall immediately be immobilized and orthopedic treatment instituted. If he gets epididymitis, the testicles shall not be elevated on a bridge across the thigh, but shall be properly immobilized. If he gets marked posterior urethritis, the discomfort of this will be mitigated at first by hyoscyamus, later by codein or even morphin, while

the prostate is repeatedly examined to detect the beginning of a prostatic abscess. If he gets retention, without stricture, this shall be considered evidence of senile enlargement of the prostate or of abscess. The proper treatment of abscess is to puncture it with the sound in the urethra or a finger in the rectum before the abscess becomes periprostatic and requires perineal drainage.

After the acute pains and irritations have begun to grow less, local treatment is begun by a few daily injections of acriflavin in the hope of rapidly diminishing the acute superficial inflammation of the mucosa. Although it is well known that the infection has reached the posterior urethra, no attempt is made to force the injection into the posterior urethra until it has begun to control the anterior urethritis. With this controlled, an astringent injection is added, the physician seeing the patient once a day to give an injection of acriflavin and the patient once a day giving himself an injection of zinc sulphate or zinc acetate 1 : 200. As the anterior urethra begins to heal, the physician attempts, perhaps with the assistance of a preliminary 10 per cent novocain injection, to force the acriflavin gently back into the posterior urethra. When the patient has become accustomed to letting this flow into the posterior urethra, the physician has three lines of choice. He may entrust the treatment very largely in the patient's own hands, in twice-a-day injections of one of the zinc solutions or he may himself continue to use the acriflavin or he may shift to 1 : 6,000 potassium permanganate as a forced irrigation into the bladder once a day. Whichever of these methods proves best adapted to the case in the early stages of its decline would be elected, but it is essential to remember that the final healing of the deeper lesions, which largely exist around the inflamed glands, both in the anterior and the posterior urethra, will not be assisted in the least by these astringent injections or any antiseptic.

The deeper lesions will get well by the lapse of time, by virtue of sexual hygiene or by mechanical local treatment. A little patience may spare the patient a great deal of mechanical local treatment and, on the contrary, a little excess of local treatment may cost the patient months and perhaps years of urethritis, prostatitis, etc. On the whole, therefore, the more successful practitioner would be he who does not try to cure gonorrhea but who tries to bring all attacks of gonorrhea into a condition where they will spontaneously get well. He will use a maximum of patience and a minimum of local treatment.

But to continue: Our patient's acute anterior and posterior urethritis is now well along in the stage of decline. There may still be free pus in both the first and second urines passed or the free pus may be only in the first flow, but massage of the prostate expresses a purulent secretion containing gonococci and there are doubtless gonococci in the anterior urethral lesions as well. Mechanical treatment is then begun by massaging the prostate very gently once or twice a week. If this occasions an acute outbreak of inflammation, we must return to our irrigations or to the purely expectant treatment until such time as the prostate may be massaged with safety. By this time the urethral dis-

charge is little more than a morning drop in which gonococci are not always present.

Now is the time to begin the passage of a 22 F. sound very gently into the anterior urethra without entering the posterior urethra. This treatment will be continued as for Case 1. By the reaction to the sound you shall recognize more clearly than in any other way, the evidence of gonococci persisting in the anterior urethra, for this reaction constitutes nothing less than the cultivation of the gonococcus in the physiological test-tube.

The difference between Cases 1 and 2 at this point is that the healing of Case 2 is much slower and that a few pus cells may forever persist in the prostatic secretion. It is vain to attack these by interminable prostatic massage. Prostatic massage, like the massage of a sound, is an admirable treatment for toning up the muscles, for expelling purulent secretions, for encouraging the absorption of exudates and the healing of subacute catarrh. But for chronic established prostatitis it is only necessary to massage long enough to be sure that gonococci have been driven out, then nothing more can be done except by sexual hygiene, which is certainly far more efficacious than any massage of the prostate or seminal vesicles.

The sound should certainly not be intemperately passed into the posterior urethra until massage has been continued long enough and the patient watched carefully enough for the experienced physician to feel assured that the passage of this sound into the posterior urethra will not excite epididymitis. I venture to assume that the inexpert physician will not attempt to pass a sound into the urethra that contains gonococci, though, alas, this assumption has no foundation. By the eighth or tenth week of the disease it is not improbable that the clinical picture of the malady will suggest that the gonococci have disappeared. There are no longer any spontaneous outbreaks of acute suppuration. Even the gentle passage of a sound does not excite any reaction in the anterior urethra. Then the sound should be passed very gently into the posterior urethra, always preceded by an injection of acriflavin. If this can be done without exciting a reaction, the complement fixation test for gonorrhea should be taken. As soon as this also is found negative, the threefold test of (*a*) absence of gonococci from the secretion, (*b*) negative culture in the physiological test-tube, (*c*) negative complement fixation test, constitutes good evidence that the gonococci have disappeared. Let the patient wait a month, at the end of which time all tests should be repeated and a guarantee of freedom given, even though there are still pus cells in the prostatic secretion.

The physician who obstinately refuses a guarantee of freedom from infectiousness to patients whose prostatic secretion continues to show pus, shows himself overprudent and drives many of his patients elsewhere for their guarantee. The difficulty with such physicians is that they go to the laboratory for a clinical opinion as to infectiousness. The laboratory will never give them an answer. Their opinion must be based primarily upon the clinical behavior of the case and supported by the laboratory findings.

Case 3.—For example, a patient is brought to me by his physician with the statement that he still has pus in his prostatic secretion and Gram-negative intracellular diplococci in his pus. This condition has persisted for six months, a year, two years, perhaps, during all of which time the prostate has been patiently massaged and the guarantee refused. Yet during all these months there has been at most a mucopurulent drop of morning discharge and there have been no subjective symptoms unless the massage has been vigorous enough to excite them. I solemnly send specimens of this patient's urine and prostatic secretion to the laboratory and learn that his Gram-negative intracellular diplococci are of the *Staphylococcus albus* family. I pass a sound. I find the gonococcus complement fixation negative and, if there is no urethral discharge, I declare the patient as well as he ever will be unless under improved sexual hygiene. I also pronounce him free from gonococci. If, however, there are any symptoms, I put him through the regular examination for chronic urethritis. Urine passed in two glasses, prostatic secretion expressed and examined, 26 F., 27 F., 28 F. bulbous bougies passed into the urethra, after meatotomy, if this be necessary, and then inspection by a straight tube water distention urethroscope through which I can examine the trigone, the bladder neck, the lateral lobes of the prostate, the floor of the posterior urethra, the verumontanum and finally the membranous and anterior urethræ.

I expect to detect lesions of the anterior urethra by the bulbous bougie. If they are so detected, they are treated by dilatation. Lesions of the posterior urethra found by the urethroscope are of considerable variety.

The patient with a mucoid morning drop, persistent for many months, usually owes this to a slight infiltration of the anterior urethra at the penoscrotal angle or at the cut-off muscle, or less frequently to granulations that look like little papillomata growing about the veru. These must be burned away with the high-frequency current, silver nitrate 20 per cent solution or other chemicals. It may well be worth while to spare the patient the pain of these treatments by giving caudal anesthesia and taking one's time with the high-frequency current. Even under anesthesia, however, this current should be applied only in the lightest manner, otherwise it will excite so grave a reaction that retention of urine or prostatic abscess or epididymitis result.

A less frequent occasion for mild persistent urethritis is inflammation of that part of the posterior urethra nearest the bladder neck. This inflammation shows itself in the swollen and red mucosa around the bladder neck and over the floor of the urethra up to the verumontanum. It may be associated with the so-called Pelouze cysts and, if it has existed over a year, it results in a sclerosis of the bladder neck which requires that the outer end of the urethroscope be tipped far below the horizontal in order to get the tip into the bladder and, as the instrument is withdrawn, it will be found that the distance from the bladder neck to the verumontanum is lengthened. This type of posterior urethritis is often associated with moderate discomfort on urination but, if it is not so severe as to cause retention of urine and if the patient can be assured

that he no longer contains gonococci, which can usually be done, once again sexual hygiene is habitually the best treatment.

These cases of posterior urethritis about the neck of the bladder have all underlying prostatitis, but the physician should realize that it is the surface lesions of the urethra that occasion the discharges of pus of which the patient complains, while chronic prostatitis and chronic vesiculitis do not of themselves excite urethral discharges, though they excite pains. The physician who realizes this will soon find that the world is full of men who, although they have chronic prostatitis or chronic seminal vesiculitis, are without this knowledge and live happy forever after.

Case 4.—A very trying type of case, however, is that of the irritable prostate or seminal vesicle. Such a patient may, from no ascertainable cause, suffer numerous relapses of epididymitis. These are usually spoken of as gonorrheal epididymitis, yet the complement fixation test will prove some non-gonococcic. Vasotomy and injection of the seminal vesicle has been much resorted to for the relief of this condition. I have not employed it nor have I imitated Still-wagon, who injects the seminal vesicle directly through the anterior wall of the rectum. If the constant wearing of a good support does not spare the patient his relapses, division of the vas deferens with its surrounding lymphatics and vessels in the upper part of the scrotum will do the trick.

There is another type of irritable prostate which exhibits itself by an acute inflammatory reaction to every instrumentation and discloses to rectal palpation the prostate, one or both of whose lobes are more or less rimmed with ridges of hard periprostatic infiltrate, while the boggy center of the lobe can be depressed with the extrusion into the urethra of a surprisingly large amount of purulent secretion, while the vesicles show similar lesions of infiltration and distention. Such a case may be benefited if for a time prostatic massage is kept up until the patient can learn sexual hygiene.

Case 5.—Once in a blue moon one encounters a patient whose resistance to gonococci is extraordinarily low. Instead of getting rid of his gonococci in three months' treatment, as he certainly should, he continues to harbor organisms that exhibit the clinical and the bacteriological characteristics of the gonococcus. I can remember one such case that was one of the few that have proven to me the occasional extraordinary efficacy of sandalwood oil. This drug he had depended upon for two years to help him out of the difficulties, such as acute prostatitis or acute epididymitis, into which local treatment at the hands of various excellent specialists had plunged him. It would only take two or three treatments to excite acute reaction and a profuse urethral discharge filled with gonococci. He then would take as much sandalwood oil as he could hold and within a week his urethral symptoms would have subsided. When he came to me, I satisfied myself of the truth of his story by giving him an epididymitis through rubbing his prostate. I then sent him around the Horn on a sailing trip with his faithful capsules. When he came back I bade him stop his capsules, not believing they were doing him any good, and though no

local treatment was given him and it was three months since he had seen a physician, as soon as he stopped the sandalwood, the activity of his urethral discharge became really quite alarming. He therefore resumed the sandalwood and while taking this we began a course of very homeopathic acriflavin injections, followed this in due time with gentle passage of sounds and gentle massage and in three months he was well.

Other Cases.—On the other hand, there are those who never will get well. There are the negroes whose scarred anterior urethras defy even the urethrotome. There are the victims of repeated prostatic abscesses whose posterior urethras exhibit to the urethroscope a landscape reminiscent of the Hindenburg Line. One is tempted to say that all of these unfortunates hold their permanent disability to bad treatment. Lack of physicians is perhaps the smallest count against them. They are generally monuments to the evils of medical enthusiasm. I am often asked what I think of the systemic treatment of gonorrhea. I think it an excellent treatment. It keeps the unqualified physician from meddling with the urethra and it permits the gonorrhea to run its more or less normal course of three to six months from infection to cure.

Acute Gonorrhea in the Male

Diagnosis

The first gonorrhea is always a vicious infection.

Subsequent attacks may be mild.

Non-gonoccocic urethritis may begin as acutely as gonorrhea.

Non-gonococcic urethritis is often far more persistent than gonorrhea.

Urethral chancre causes a discharge of pus.

Even at the onset, smears merely strengthen an impression as to the presence or absence of gonococci. They prove nothing absolutely.

Smears are useful chiefly to mark the progress of the disease from day to day.

If no Gram-negative intracellular diplococci are found in the smear, they may still be in the urethra or prostate.

If Gram-negative intracellular diplococci are found, they may be staphylococci or other bacteria.

Treatment

Any local treatment that causes pain is harmful.

Do not conceal pain by local anesthesia.

When symptoms do not promptly subside under local treatment this should be discontinued.

The character of the injection used is of far less moment than the intelligence with which it is used. The man behind the gun is more important than the solution in it.

When the inflammation has reached its height, local treatment will only make it worse.

If one local treatment fails, do not shift; all other treatments will also fail.

Treatment of the Declining Stage

In the declining stage of an acute gonorrhea, the patient's physician has a unique opportunity for doing him harm.

Intemperate instrumentation causes more chronic gonorrhea than the gonococcus itself.

Do not at first introduce any instrument into the urethra except a soft rubber catheter. Later the sound.

Our great-grandfathers got well without local treatment.

Try all the new systemic remedies for gonorrhea; you will be surprised at their efficacy. They keep your hands off.

Antiseptics are useful only to control the mildest infection.

The older the infection, the more benefit will be obtained from the astringents (zinc, permanganate, silver).

Chronic Gonorrhea in the Male

Diagnosis of the Presence of Gonococci

The smear is fallacious.

The complement fixation test is fallacious unless there is considerable infection (prostate, vesicle, joint).

A positive culture is the only positive proof of the presence of gonococci.

The place to cultivate the gonococcus is in the patient's own urethra.

The gentle passage of a sound cracks infiltrated spots containing gonococci. These set up a recognizable gonorrheal urethritis. This is controllable, thanks to established local immunity and to immediate antisepsis.

Rough instrumentation will do this, but the reaction will be uncontrollable.

The patient will draw his own conclusion as to the intelligence of the physician who attempts to diagnose the presence of gonococci when the clinical course of the infection points plainly to their presence.

When the gonococci have gone the infection settles down to a mild catarrh interrupted, if at all, only by sexual upheavals in prostate and vesicles.

The formula, "complement fixation diagnoses prostate and vesicles; sounds diagnose anterior urethra," is fairly safe.

Diagnosis of the Urethral Lesion

The purulent discharge signifies a lesion on the surface of the urethra.

A prostate full of pus is a silent pool unless its surface is ruffled.

You cannot see pus in the prostatic secretion without a microscope.

You cannot obtain adequate evidence of prostatitis and vesiculitis without massage.

Lesions in the anterior urethra are infiltrations.

They are detected by the bulbous bougie.

Almost all mild morning drops are due to anterior urethritis.

You may need a 28 F. bulb to detect the infiltrate.

Cut the meatus promptly.

The urethroscope shows lesions of the anterior urethra but rarely helps treat them.

The urethroscope shows lesions in the posterior urethra and it is often necessary to treat them.

Treatment

These cases did so well in the army because:

1. Their sexual hygiene was good,
2. Their general hygiene was good,
3. The doctors had no time to poke them very much.

Before beginning to treat chronic gonorrhea consider what you may expect:

1. The gonococci will disappear of themselves in a year.
2. A prostate showing pus in its discharge will probably show pus forever after. The prostatic prognosis depends more upon sexual hygiene than upon massage.
3. The seminal vesicles behave like the prostate.
4. Infiltrations of the anterior urethra will disappear under gentle dilatation unless they contain real scar.

The gonococcus is often best driven out by patience and hygiene.

The local attack upon the gonococcus must reach beyond the surface of the mucous membrane.

Massage reaches beneath the surface.

The sound is used to massage the anterior urethra.

Not one man in five has gentle enough hands to use the sound profitably. If your patient gets an epididymitis, you have yourself to blame.

Treatment of Epididymitis

The patient must rest.

The sore epididymis requires immobilization against the belly wall, just as a sore joint requires immobilization.

The adhesive plaster bridge across the thighs does not immobilize.

Local applications to the scrotum are of little value.

Ice numbs the pain.

If immobilization fails to relieve symptoms, operate.

Treatment of Stricture

The instrumentation that makes a stricture bleed adds to its scar.

Recent strictures can be dilated.

Ancient strictures of the bulb can be dilated.

Ancient strictures of the penile urethra cannot be dilated.

Only that portion of the obstruction which is edema and cellular exudate can be absorbed.

Only gentle dilatation—massage can do this.

The scar is forever.

The scar in the bulb is habitually so wide as not to require cutting.

The scar in the penile urethra habitually requires cutting.

Three months after urethrotomy of the penile urethra the stricture should be fully dilated and healed and a bulbous bougie should not detect recontraction a year thereafter.

But the negro does not do so well.

And stricture in the bulb requires dilatation forever.

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